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THE STEREOSCOPE IN THEORY AND PRACTICE, ALSO A NEW PRECISION TYPE STEREOSCOPE

BY

EMANUEL KRIMSKY, M.D.

NEW YORK

ONE of the unfortunate aspects of stereoscopic investigation is that the practitioner is confronted with advanced optical principles and calculations which are not simplified or interpreted for practical adaptation. The stereoscope, because of generalities and ambiguities, has been made to appear, in spite of its increasing popularity, an undignified *modus operandi*. The author has attempted to interpret the optical principles underlying the use of the stereoscope so that the reader may better appreciate the operation and value of a calibrated stereoscope.

The considerations in this paper may be grouped under two main headings—theoretical and practical—as follows:—

1. THEORETICAL—STEREOSCOPIC OPTICS.

   (*a*) *Perspective.*

   Visual and Geometric Axes.

   The Simple Stereoscope, and its Relation to the Visual and Geometric Axes.

   (*b*) The Metre Angle and Convergence.

   The Metre Angle in Stereoscopy.

(*c*) Variations in Convergence induced by Ametropia in Relation to Stereoscopy.

(*d*) Terms used to express Fusional Status with use of Stereoscope.
Phoria and Tropia Points.
Relative Normal Fusional Stereovergence.
Active and Passive Fusion with Stereoscope.
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(*e*) Relative Normal Fusional Stereovergence.
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(*f*) Angle of View and Field of View.
Factors governing size of Angle of View.
Factors governing size of Field of View.

(*g*) Interpupillary *vs.* Interlenticular Separation.

(*h*) Apparatus Convergence.

(*i*) The Stereogram.
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2. PRACTICAL.

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Versus the Holmes Stereoscope.
Requirements of a Precision Stereoscope.
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The Stereoscope in Diagnosis.
The Stereoscope in Orthoptic Training as applied to the particular muscle anomaly:—
Convergence Excess. (Esophoria or Esotropia for near).
Convergence Insufficiency. (Exophoria or Exotropia for near).
Divergence Excess. (Exophoria or Exotropia for far).
Divergence Insufficiency. (Esophoria or Esotropia for far).

Perspective

In the fields of topography and art, perspective represents the projection of parallel rays to a vanishing point. In the field of ophthalmology perspective points to a condition identified with depth perception, but beyond this we find no attempt to analyse the basis for that phenomenon. A little reflection should reveal the folly of employing both terms synonymously. If by perspective we refer to angulation of parallel lines as registered by means of a lens on a ground glass, then a short-focus photographic lens should provide enhanced perspective. If by perspective we mean long-range three-dimensional stereo-power, then a long focus photographic lens or a binocular should fill these requirements, inasmuch as the stereo-power is directly proportional to the numerical magnification of the lens system employed.

For practical purposes, let us take the case of the railroad track and the subject standing midway with his eyes in the primary position and gazing into infinity. In relation to our eyes, the tracks diverge proximally and converge with distance (Fig. 1, 2, and 3). That the tracks are not parallel we call an optical illusion. If the tracks were endowed with eyes, they might say that our eyes

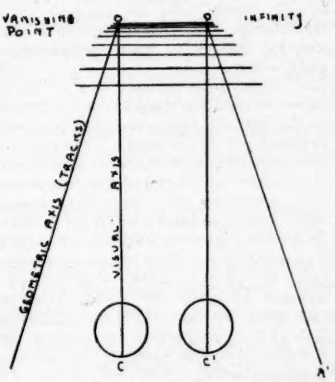


FIG. 1.

Eyes in primary position and their visual axes in relation to parallel railroad tracks which we shall call geometric axes. In relation to tracks, the eyes are in a state of relative convergence. In relation to visual axes tracks are in a state of relative divergence. Points O and O′ represent juncture or vanishing points of both geometric and visual axes.

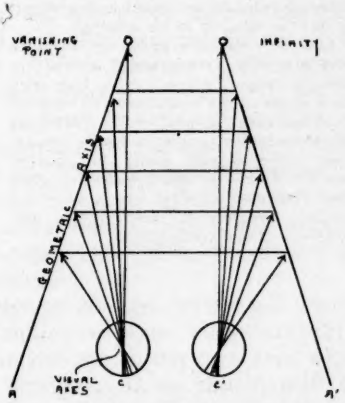


FIG. 2.

Theoretical representation of divergences of visual axes required to fuse images of tracks at variable distances.

In actual state, parallelism represents the limit of divergence of the visual axes.

converge when they diverge; and that we diverge when they converge, even though our eyes are perfectly straight. We may regard this as a case of optical relativity. And so if we should reconstruct the visual projection lines in relation to the parallel tracks which to our senses appear convergent (for far), we have

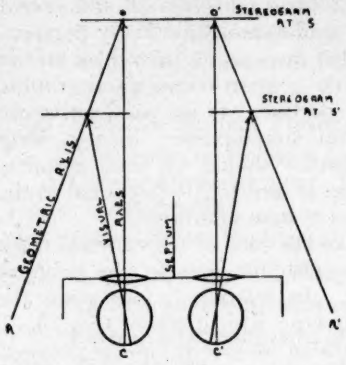


FIG. 3.

Showing relation of visual and geometric axes as applied to stereoscope.
S and S′ represent apparent variable positions of a stereogram at and within infinity ranges respectively, but with their separations unaltered, in relation to visual axes OC and O′C′. Whereas the stereogram centres actually remain fixed when moved along the parallel axes OC and O′C′ they appear distinctly divergent at S′ (as in the case of the tracks), because of the relative convergence of the visual axes.

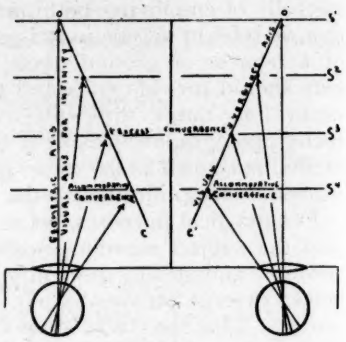


FIG. 4.

Illustrating the progressive convergences of the visual axes as applied to the stereoscope, but with the geometric axes (tracks) shifted to their actual state of parallelism.
(Disproportion in inter-ocular separations should be discounted). Whereas in the last diagram, the visual axes are represented as relatively convergent to the geometric axes, here we find them to correspond to their actual state—with the geometric and visual axes meeting only with the eyes directed for infinity as in last diagram. S1, S2, S3, S4 show the changeable positions which stereogram (and its central dots) would have to assume to meet the visual axes with changing accommodations. The lines CO and C′O′ formed by joining these projection points we shall call the visual vergence axes.

a relationship such as is depicted in Fig. 4, in which our eyes would have to diverge considerably for near, and progressively less with receding distance in order to translate to our senses a parallel arrangement. This raises the interesting problem as to what arrangement the tracks would have to assume in order to appear parallel to our eyes when looking into infinity, but I shall not involve myself in such intricacies in this article, except to state that such projecting lines (of parallel tracks) imply gradations in the sizes of retinal images with receding distance.

If we could preserve the same size of retinal image with projection in space, then the element of converging lines is destroyed, even though other elements of depth perception such as light and shade and atmospheric haze will register in us an appreciation of stereoscopic sense.

Nor is this problem essentially a binocular one, for monocularly the same effect is registered by shifting one eye to either direction so as to emulate the divergence and convergence properties of binocular function. In either instance this shifting of the eyes to gauge distance through perspective we call parallax.

By juggling the two sets of lines so as to nullify the element of perspective or convergence in these railroad tracks to their state of actuality, and shifting the visual lines accordingly, we find our eyes in a state of relative convergence for near which diminishes with receding distance. By bearing this analogy in mind, it becomes easier to understand the phenomena associated with stereoscopic perception through a stereoscope.

A stereoscope in its simplest form consists of two lenses whose optical centres correspond to the average pupillary separation of, say 60 mm. and which are in direct geometrical relationship with the corresponding points on two split charts of a stereogram of equivalent separation. Whether we move the stereogram away from or towards the lenses will not alter the parallelism of the geometric axes. If now in place of, or in addition to these stereoscopic lenses we employ two human lenses (as in Fig. 4), we find their axial relationships to these pictures to vary as the charts are moved away from or towards the eyes, as in the case of the tracks. In other words, the visual axes and the geometrical axes do not correspond (except at infinity range), and, as will be shown later, this discordance between visual and geometric axes varies depending on the focal lengths of the lenses employed in the stereoscopic eyepiece, and on the viewing distance.

However, our eyes may converge or diverge, we are not usually mindful of these alterations in a subjective sense, but always think of positions of objects in space in relation to our own eyes which we unconsciously assume to be straight. If we should shift the visual axes back to a position of parallelism (as in Fig. 3), and move the geometric axes accordingly, we now observe that the geometric axes which were formerly parallel (Fig. 4), are now distinctly divergent (within infinity), in relation to the visual axes which have now been rendered parallel. This apparent divergence is most marked nearer to the eyes, and diminishes with receding distance. It also explains why two vertical lines on a stereogram that are readily fused at the far point of the corrected lens system, lose this power, and become distinctly and increasingly divergent when brought closer to the eyes.

The Metre Angle and Convergence

The term " metre angle " usually refers to the angle of convergence which each eye must bring into play when focusing on to a single point at a fixed distance from both eyes. It also may be represented as one-half the amount of deviation produced by both eyes. Whether the eyes be hyperopic or myopic does not matter so long as that fixed point is seen binocularly. We may also think of the metre-angle as the amount of convergence required to displace the visual axes of each eye from a position of parallelism

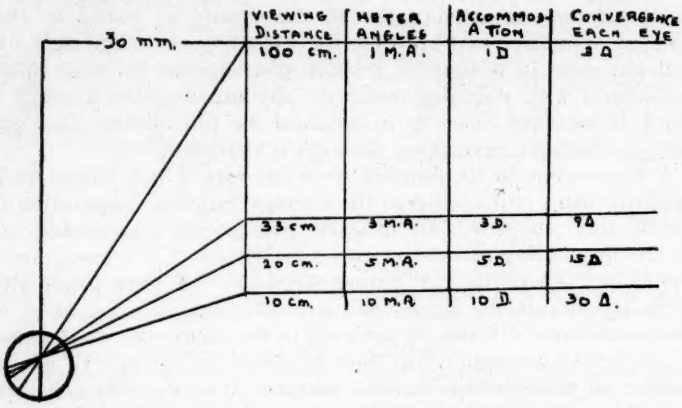


FIG. 5.

A. Variations in amount of convergence required to displace visual axis of each eye through the same extent (30 mm.) at different viewing distances.

B. Values of some of the multiples of the metre-angle corresponding to an inter-ocular distance of 60 mm. in terms of degrees and prism dioptres.

From W. S. Duke-Elder, " THE PRACTICE OF REFRACTION "

METRE ANGLES	DEGREES	PRISM DIOPTRES (Approximate)
1	1° 43·15′	3·00
2	3° 26·39′	6·00
3	5° 9·82′	9·0
4	6° 53·53′	12·0
5	8° 37·62′	15·1
6	10° 22·19′	18·2
7	12° 7·34′	21·5
8	13° 53·19′	24·8
9	15° 39·86′	28
10	17° 27·46′	31
11	19° 16·13′	35
12	21° 6·00′	38·5
13	22° 57·27′	42·3
14	24° 54·08′	46
15	26° 44·62′	50
16	28° 41·12′	54·5

to a medial axis; and for a pupillary separation of 60 mm. it would mean a convergence of each axis medially to the extent of 30 mm. As shown in Fig. 5, the number of metre-angles varies with the viewing distance. Also, variations in the amount of pupillary separation exercise slight but appreciable differences in the value of the metre-angle. The greater the separation, the greater the value of that angle, and *vice versa*.

In looking through a stereoscope, we determine aberrations of convergence in terms of prism dioptres (or metre-angles) not in relation to a single fixed central point, but through the incorporation of suitable plus spheres in relation to calculated projection points.

Variations in Convergence induced by Ametropia

Just as refractive errors are theoretically apt to alter the directions of the visual axes at infinity range, so may they induce characteristic changes within infinity range.

In hyperopia, we may theoretically expect a medial displacement of the visual vergence axes at all ranges (as compared to emmetropia) due to the superadded accommodative convergence. In actual practice, however, the results are variable.

In myopia, we may theoretically expect a lateral displacement of the visual vergence axes at all ranges (as compared to emmetropia) due to diminished accommodative effort. Here, too, the actual results often vary.

Terms used to express Fusional Status

If a Wells B2 or B3 Phoria or Dobson's Index chart be inserted in the stereoscope, say at infinity range, the eyes will select a line crossing or a numbered ball corresponding to the most comfortable position of both eyes at that range. If the subject chooses the No. 6 ball (60 mm. separation) corresponding to a like lenticular separation, we say that he is orthophoric for infinity in the primary position. We speak of this as the *selective or passive fusion*, inasmuch as it is effortless; for were the subject confronted with but two vertical lines or two balls at different separations, say 50 mm. or 70 mm., he would most likely fuse them too. In the latter instance we speak of *active fusion*.

The *phoria point* is the selective fusion point in relation to the calculated vergence points which the patient fuses. The calculated vergence point for infinity range corresponds to the primary position of the eyes, and if the subject selects the 60 mm. crossing with the Wells B3 chart, we say there is no phoria point. For further confirmation we may insert a base-down prism over either eye, and repeat the operation; and then after the eyes have come

to rest on a particular number, repeat our reading. If at that distance the patient selects the 30 mm. crossing, his phoria is 30 mm. less than his orthophoria (60 mm.), and by referring to the proper table we can express this esophoria in terms of a definite number of prism dioptres. If the 90 mm. crossing be selected, we may for the present state that there are 30 mm. of exophoria for far. The *tropia point* is an exaggerated phoria point, and may be represented as that amount of separation of a split stereogram which the eyes can approximate or superimpose.

A modified phoria chart may also be extended to include the testing of vertical phoria. In the absence of any hyperphoria, one would expect the arrow to cross the vertical rule at the " O " or horizontal level. If the horizontal rule crosses the vertical rule above the " O " it points to a left hyperphoria; if it crosses below the " O," to a right hyperphoria. These vertical displacements may then be translated in terms of prism dioptres of right or left hyperphoria.

The *range of fusion* (or fusional reserve or fusion amplitude) is, as its name implies, the range of linear separations of the split

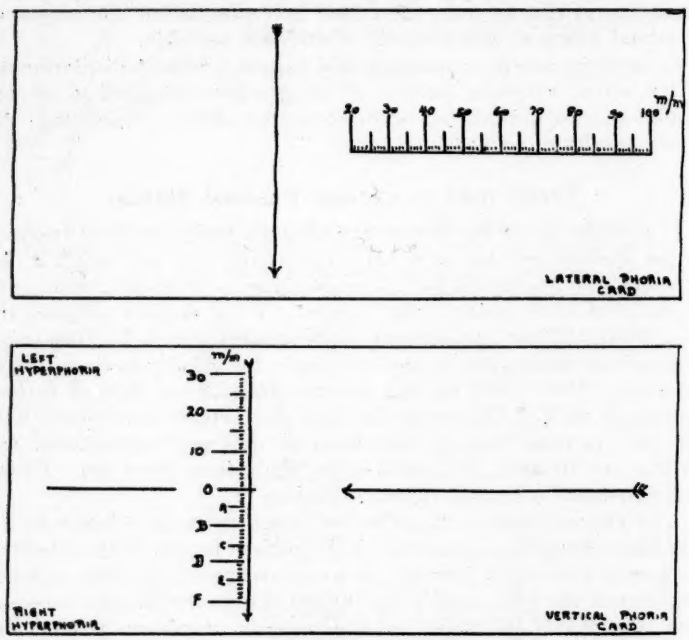


FIG. 6.

Author's Modified Phoria Charts for fixed stereogram holders.

halves of a stereogram which the eyes can successfully fuse. If the extent of such fusion at infinity range be represented at from 50 mm. to 70 mm., we may for the present state that there are 20 mm. of fusion amplitude at that viewing distance.

As we bring the Wells B2 or B3 stereogram closer to the eyes, well within infinity range, we find that the emmetrope no longer selects the No. 6 (60 mm. separation) ball, but one of a lesser separation, say the No. 2 or No. 3 ball. This represents the positive convergence which the eyes automatically bring into play with accommodation, and must not be confused with the phoria point, but should be regarded as the normal selective fusional point for the particular range chosen. We term this the *relative normal fusional stereovergence* (or accommodative convergence), and forms part of the visual vergence axis (Fig. 4). And just as the phoria point is calculated in relation to the No. 6 ball at infinity range, so will the phoria point be determined in relation to, say No. 3 ball at a particular accommodative range.

Relative Normal Fusional Stereovergence

The relative normal stereovergence depends on :—

(*a*) The position of the geometric axes.

(*b*) The strength of the viewing lenses.

(*c*) The viewing distance.

(*a*) The geometric axes maintain their parallelism in the simple, non-prismatic stereoscope.

(*b*) The greater the strength of the plus lenses used in viewer, the less will be the accommodation and convergence (or visual vergence axis displacement) at a fixed distance, and *vice versa.*

(*c*) It has already been established that the selective fusion for near with a phoria chart will yield, say 30 mm. instead of 60 mm. separation. We are now in a position to calculate beforehand what separation (or No. ball) the emmetrope should select on the basis of the position of the geometric axes, the viewing distance, and also on the strength of the lenses used in viewer.

For our introductory study of relative normal fusional stereovergence, let us take the case of an emmetrope using a simple stereoscope with an inter-lenticular separation of 60 mm. From such an arrangement, we can base our calculations in relation to the parallel geometric axes, and to the midline (septal partition). To demonstrate the changeable normal accommodative vergences with such a simple arrangement, not only in relation to viewing distance, but also in relation to the dioptric strength of the lenses employed, the author presents three charts, representing the findings with plus 2 D., 3 D., and 5 D. lenses respectively. As may

FIG. 6A.—VISUAL VERGENCE CHART No. 1. FOR PLUS 3D. SPHERES (33 cm. Focal Length).
INTER-LENTICULAR SEPARATION = 60 mm. ORTHOPHORIC CALCULATIONS.

COLUMN NUMBERS.

-1-	-2- -3-	-4A- -4B-		-5-	-6A- -6B-		-7-	-8-	-9-	-10-
VIEWING DISTANCE	DIOPTRES OF ACCOMMOD. AND EQUIVAL. METRE A EACH EYE	FUSIONAL STEREO-VERGENCE (Prism Dioptres) ONE EYE	BOTH EYES	LINEAR VALUE OF 1 PRISM DIOPTRE	FUSIONAL STEREO-VERGENCE IN MM. FROM GEOM. AXIS	SEPTUM	WELLS B3 VISUAL AXIS SEPARATION	WELLS B2 BALL No.	DIVERGENCE TO FUSE No. 6 BALL (Prism Dioptres)	PRISM VALUE OF 1 MM.
10 cm.	7·	21·	42·	1· mm.	21·	9·	18·	2	42·	1· Prism Diopt.
11 cm.	6·1	18·3	36·6	1·1 ,,	20·1	9·9	19·8	2	36·6	·91
12 cm.	5·3	16·5	33·	1·2 ,,	19·8	10·2	20·4	2	33·	·83
13 cm.	4·7	14·1	28·2	1·3 ,,	18·3	11·7	23·4	2	28·2	·77
14 cm.	4·1	12·3	24·6	1·4 ,,	17·2	12·8	25·6	2–3	24·6	·71
15 cm.	3·7	11·1	22·2	1·5 ,,	16·5	13·5	27·	3	22·2	·67
16 cm.	3·2	9·6	19·2	1·6 ,,	15·5	14·5	29·	3	19·2	·625
17 cm.	2·9	8·7	17·4	1·7 ,,	14·8	15·2	30·4	3	17·4	·59
18 cm.	2·6	7·8	15·6	1·8 ,,	14·	16·	32·	3	15·6	·56
19 cm.	2·3	6·9	13·8	1·9 ,,	13·	17·	34·	3–4	13·8	·53
20 cm.	2·	6·	12·	2·0 ,,	12·	18·	36·	3–4	12·	·5
21 cm.	1·8	5·4	10·8	2·1 ,,	11·3	18·7	37·4	4	10·8	·48
22 cm.	1·5	4·5	9·	2·2 ,,	10·	20·	40·	4	9·	·445
23 cm.	1·3	4·	8·	2·3 ,,	9·2	20·8	41·6	4	8·	·435
24 cm.	1·2	3·6	7·2	2·4 ,,	8·5	21·5	43	4	7·2	·42
25 cm.	1·	3·	6·	2·5 ,,	7·5	22·5	45·	4–5	6·	·4
26 cm.	·85	2·55	5·1	2·6 ,,	6·6	23·4	46·8	4–5	5·1	·39
27 cm.	·71	2·13	4·26	2·7 ,,	5·8	24·2	48·4	5	4·26	·37
28 cm.	·57	1·71	3·42	2·8 ,,	4·8	25·2	50·4	5	3·42	·36
29 cm.	·44	1·32	2·64	2·9 ,,	4·	26·	52·	5	2·64	·345
30 cm.	·33	1·	2·	3·0 ,,	3·	27·	54·	5–6	2·	·333
31 cm.	·23	·7	1·4	3·1 ,,	2·2	27·8	55·6	5–6	1·4	·32
32 cm.	·13	·42	·84	3·2 ,,	1·34	28·7	57·4	6	·84	·31
33 cm.	0	0	0	3·3 ,,	0	30·	60·	6	0	·3

be expected, the far points for these different lens systems will vary; in the case of the 2 D., being 50 cm.; the 3 D. 33 cm. and with the 5 D., 20 cm.

The dots in this diagram are plotted according to column 6B of visual vergence chart (Fig. 6A). They also indicate the positions through which the stereogram centres would have to be shifted in relation to upper fixed rule to correspond to easiest fusion

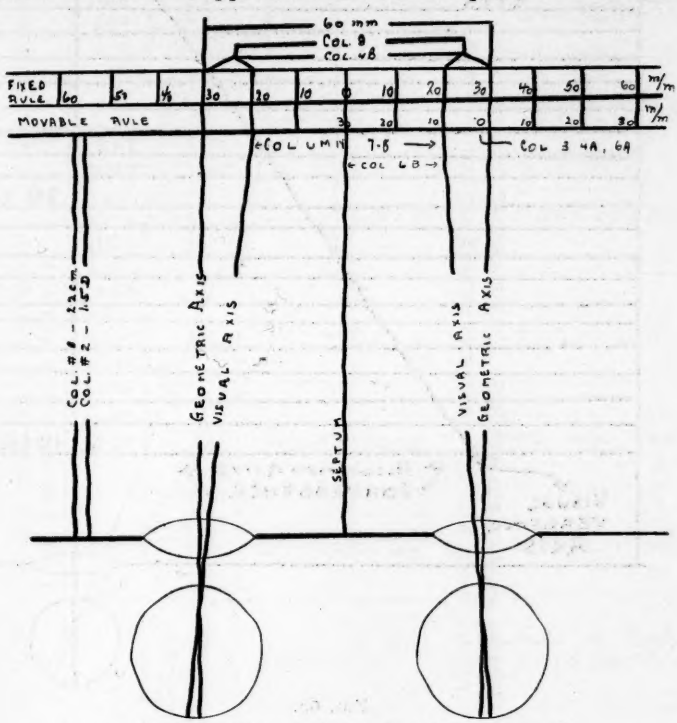


FIG. 6B.

Explanatory diagram of visual vergence chart applied to author's stereoscope at viewing distance of 22 cm. using plus 3 D. spheres.

for these various viewing distances. By joining these numerous dots, we obtain a straight diagonal line which we shall call the *visual vergence axis,* which demarcates the zone of excessive convergence on one side, and the relative divergence (or accommodative convergence) on the other. As will be noted, the prismatic value for this excessive convergence remains constant irrespective of the viewing distance or its linear extent, for the displacement of the prism dioptre changes with distance. The

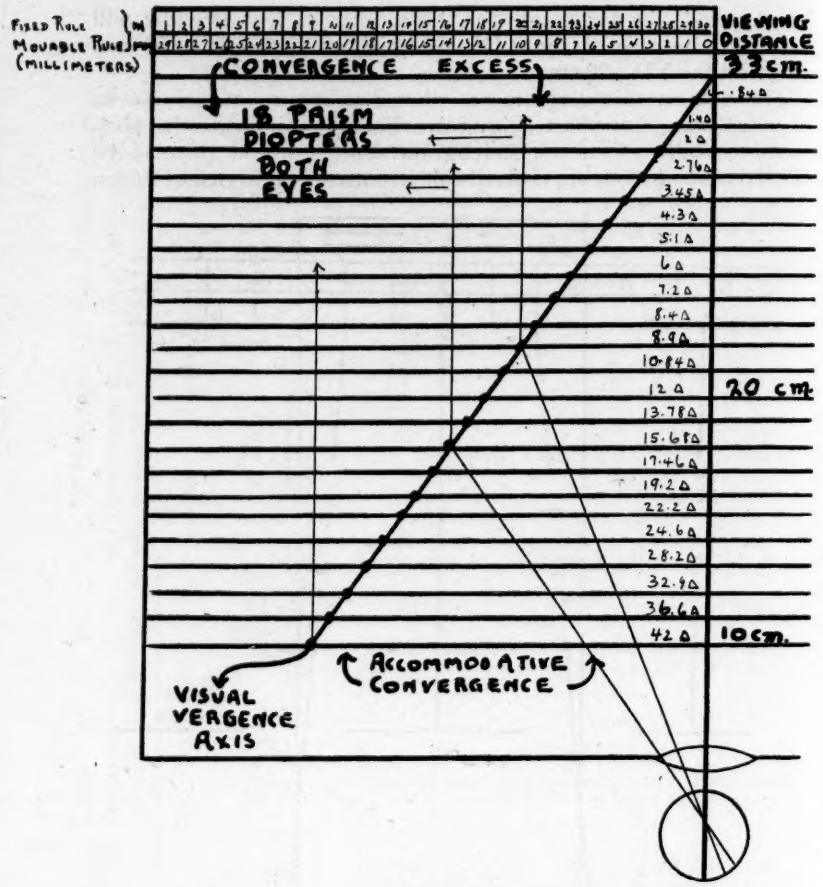


FIG. 6c.

Illustrating application of aforementioned visual vergence chart to stereoscopic readings.

range of relative divergence (or accommodative convergence), however, registers gradually increasing prismatic readings.

Note: If we were to reconstruct the visual vergence chart for plus 5 D. viewing lenses, the excessive convergence range would be increased to 30 prism dioptres with a 60 mm. interlenticular separation, and to 40 prism dioptres with an 80 mm. interlenticular separation. The excessive convergence range (for far) may be further increased to almost 70 prism dioptres by using plus 8 D. viewing lenses with an 80 mm. separation (Fig. 9).

FIG. 7.—VISUAL VERGENCE CHART NO. 2. FOR PLUS 2 D. SPHERES (50 cm. Focal Length).
INTER-LENTICULAR SEPARATION=60 mm. ORTHOPHORIC CALCULATIONS.

	COLUMN NUMBERS.									
-1-	-2- -3-	-4A- -4B-		-5-	-6A- -6B-		-7-	-8-	-9-	-10-
VIEWING DISTANCE	DIOPTRES OF ACCOMMOD. AND EQUIVAL. METRE A EACH EYE	FUSIONAL STEREO-VERGENCE PRISM DIOPTRES		LINEAR VALUE OF 1 PRISM DIOPTRE IN MM.	FUSIONAL STEREO-VERGENCE IN MM. FROM		WELLS B3 VISUAL AXIS SEPARATION MM.	WELLS B 2 BALL No.	DIVERGENCE TO FUSE No. 6 BALL PRISM DIOPTRES	PRISM VALUE OF 1 MM.
		ONE EYE	BOTH EYES		GEOM. AXIS	SEPTUM				
10 cm.	8	24'	48'	1'	24	6	12	1	48	1' Prism
15 cm.	4·67	14'	28'	1·5	21	9	18	2	28	·67 Dioptre
20 cm.	3'	9'	18'	2'	18	12	24	2–3	18	·5
25 cm.	2'	6'	12'	2·5	15	15	30	3	12	·4
30 cm.	1·33	4'	8'	3'	12	18	36	3–4	8	·33
35 cm.	·857	2·55	5·1	3·5	9	21	42	4	5	·286
40 cm.	·5	1·5	3'	4'	6	24	48	5	3	·25
45 cm.	·22	·66	1·32	4·5	3	27	54	5–6	1·2	·22
50 cm.	0	0	0	5·0	0	30	60	6	6	·2

FIG. 8.—VISUAL VERGENCE CHART NO. 3. FOR PLUS 5 D. SPHERES (20 cm. Focal Length).
INTER-LENTICULAR SEPARATION=60 mm. ORTHOPHORIC CALCULATIONS.

10 cm.	5'	15'	30'	1'	15'	15'	30	3	30'	1'
11 cm.	4·9	12·27	24·5	1·1	13·53	16·5	33	3	24·5	·91
12 cm.	3·3	10·1	20·2	1·2	12'	18'	36	3–4	20·2	·83
13 cm.	2·7	8'	16'	1·3	10·4	19·6	39	4	18'	·77
14 cm.	2·1	6·3	12·6	1·4	8·82	21·2	42	4	12·6	·71
15 cm.	1·67	5'	10'	1·5	7·5	22·5	45	4–5	10'	·67
16 cm.	1·25	3·75	7·50	1·6	6'	24'	48	5	7·5	·625
17 cm.	·88	2·65	5·3	1·7	4·5	25·5	51	5	5·3	·59
18 cm.	·555	1·67	3·35	1·8	3'	27'	54	5–6	3·35	·56
19 cm.	·263	·79	1·58	1·9	1·5	28·5	57	6	1·58	·53
20 cm.	0	0	0	2·0	0	30'	60	6	0	·5

Each chart (visual vergence chart) is tabulated under the following headings (or column numbers):—

1. *Viewing distance.*

2. *Dioptres of accommodation* for viewing distance, or the calculated accommodation for that distance minus the dioptric strength of the lenses employed. For example, the accommodation at a distance of 10 cm. with plus 5 D. lenses in viewer would be 10 D. minus 5 D. or 5 dioptres.

3. *Equivalent metre-angles.*—Which has the same value as the calculated accommodation. It indicates the fusional or accommodative stereovergence.

4. *Prismatic equivalent or metre-angle reading.*—For a lenticular separation of 60 mm., one metre-angle is equivalent to three prism dioptres; for 70 mm., one metre-angle equals 3·5 prism dioptres; and for 80 mm., four prism dioptres.

5. *Lateral displacement per prism dioptre.*—While a prism dioptre indicates a lateral deflection of a ray to the extent of 1 cm. at a distance of 100 cm., it also means a proportionately decreasing displacement with decreasing distance. So that at 20 cm. the deviating effect would be 2 mm., and at 10 cm. only 1 mm. irrespective of the strength of the viewing lenses.

6. *Displacement of visual axis in relation to geometric axis and to midline.*—This is determined by multiplying the number of prism dioptres by the linear value of the prism dioptre for the particular range desired. By referring to visual vergence chart No. 1, we note that the fusional stereovergence for each eye at a range of 20 cm. is 6 prism dioptres (Col. 4A), which means that the visual axis of each eye has been displaced medially from each geometrical axis by 12 mm. (Col. 6A). And if we set our geometrical reading at 30 mm. from the midline, the pointer would fall 12 mm. medial to the 30 mm. line, or 18 mm. from the midline (Col. 6B).

7. *Separation of the visual axes* (Wells B3 reading).—If, in the above instance, the vergence reading for each eye is 18 mm. from the septum, then the visual axes are 36 mm. apart.

8. *Reading with Wells B2 chart.*—This roughly corresponds to the separation of the visual axes in millimetres.

9. *Divergence required to select the No. 6 ball.*—Or the amount required to nullify the accommodative convergence (as in Col. 4B).

10. *Prism value of 1 mm. displacement of visual axes for each eye.*—Transpose the reading in column 5.

Computation Problems

With the aid of visual vergence chart No. 1, we may ask ourselves such simple practical questions as:

1. How much accommodative convergence will the orthophoric find easiest at a distance of 16 cm.? Answer—19·2 prism dioptres (Col. 4B) with 3·2 D. accommodation.

2. How shall we set our split charts to correspond to such a convergence? Answer—each chart centre should be 14·5 mm. from septum (6B).

3. To what number ball with Wells B2 chart would normal fusional stereovergence correspond to at that distance? Answer—No. 3 ball.

4. If the patient selects the No. 2 ball with this arrangement of the stereoscope at (16 cm.), what would you conclude? Answer—that he has about 10 mm. of esophoria, or, according to column 10, 10 × ·62 prism dioptres or 6·2 prism dioptres of esophoria for near. The Wells B2 is a very rough method of determining the approximate phoria. The Wells B3 with the horizontal rule calibrated in millimetres would be the desirable method of making our calibrations.

5. If the patient selected the No. 6 ball at that distance what would you conclude? Answer—that he has a convergence insufficiency to the amount of 18 prism dioptres (column 10, 30 mm. × ·625 or 18·75).

6. If he selected the 20 mm. crossing at the infinity range of the plus 3 D. viewing lenses? Answer—divergence insufficiency, equivalent to 60 minus 20 or 40 mm., or according to column 10, 12 prism dioptres (40 × ·3) of esophoria for far.

7. If he selected the 90 mm. crossing at infinity range with these lenses? Answer—divergence excess equal to the difference between 90 mm. and 60 mm. or 30 mm. By again consulting column 10 of said chart we derive a reading of 9 prism dioptres of exophoria for far (30 × ·3).

8. Supposing the patient is known to have 10 prism dioptres of exophoria at a distance of 20 cm., what would be the most comfortable inter-stereogram separation for such a divergence? Answer—At 20 cm. distance, the most comfortable inter-stereogram separation would be 36 mm. (Col. 7). Ten prism dioptres of exophoria would imply an additional separation of 2 mm. for each prism dioptre (Col. 5), or, 20 mm. in addition to the orthophoric 36 mm. reading, making a total of 56 mm.

9. How much excessive convergence would be required to fuse two upright pencils 20 mm. apart at a distance of 20 cm. with these lenses? Answer—according to column 7, the normal fusional stereovergence at that distance would correspond to a visual axes separation of 36 mm. The extra 16 mm. of convergence would amount to 16 × ·5 or 8 prism dioptres of excessive convergence (Col. 10).

FIG. 9.—PRISMATIC EQUIVALENT CHART NO. 4.

Prismatic equivalent per unit displacement on movable rule.

DISPLACEMENT IN MILLIMETRES.

Viewing Distance	5 mm.	10 mm.	15 mm.	20 mm.	25 mm.	30 mm.	35 mm.	40 mm.
		PRISM DIOPTRES						
40 cm.	2·5	5·	7·5	10·	12·5	15·	17·5	20·
33 cm.	3·	6·	9·	12·	15·	18·	21·	24·
32 cm.	3·1	6·2	9·3	12·4	15·5	18·6	21·7	24·8
31 cm.	3·2	6·4	9·6	12·8	16·	19·2	22·4	25·6
30 cm.	3·3	6·6	10·	13·	16·5	20·	23·	26·
29 cm.	3·4	6·8	10·2	13·6	17·	20·4	23·8	27·2
28 cm.	3·6	7·2	10·8	14·4	18·	21·6	25·2	28·8
27 cm.	3·7	7·4	11·1	14·8	18·5	22·2	25·9	29·6
26 cm.	3·9	7·8	11·7	15·6	19·5	23·4	27·3	31·2
25 cm.	4·	8·	12·	16·	20·	24·	28·	32·
24 cm.	4·2	8·4	12·6	16·8	21·	25·2	29·4	33·6
23 cm.	4·3	8·6	12·9	17·2	21·5	25·8	30·1	34·4
22 cm.	4·5	9·	13·5	18·	22·5	27·	31·5	36·
21 cm.	4·8	9·6	14·4	19·2	24·	28·8	33·6	38·4
20 cm.	5·	10·	15·	20·	25·	30·	35·	40·
19 cm.	5·3	10·6	15·9	21·2	26·5	31·8	37·1	42·4
18 cm.	5·6	11·2	16·8	22·4	28·	33·6	39·2	44·8
17 cm.	5·9	11·8	17·7	23·6	29·5	35·4	41·3	47·2
16 cm.	6·2	12·4	18·6	24·8	31·	37·2	43·4	49·6
15 cm.	6·6	13·	20·	26·4	33·	40·	46·	53·
14 cm.	7·1	14·2	21·3	28·4	35·5	42·6	49·7	56·8
13 cm.	7·7	15·4	23·	30·5	38·	45·5	53·	61·
12 cm.	8·3	16·6	24·9	33·2	41·5	49·8	58·1	68·4
11 cm.	9·1	18·2	27·3	36·4	45·5	54·6	63·7	72·8
10 cm.	10·	20·	30·	40·	50·	60·	70·	80·

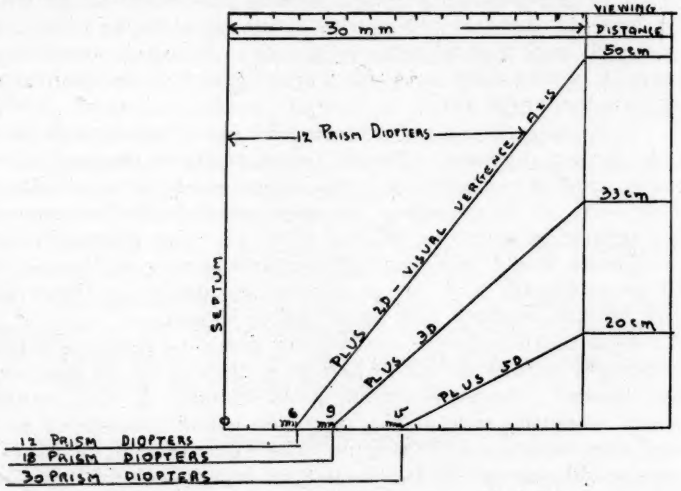


FIG. 10.

Comparative visual vergences with plus 2 D., 3 D., and 5 D. spheres respectively.

The Angle of View and the Field of View

The angle of view with the stereoscope is, as its name implies, the angle which the halved stereogram subtends on the eye. There are certain factors which govern the size of this angle:

1. The viewing distance.
2. Diameter of viewing lens.
3. Strength of viewing lens.
4. Conformations and restrictions offered by viewing frame.
5. Size of stereogram.
6. Lenticular Separation.

The viewing angle (for each eye) may in turn be subdivided into two component angles (Fig 11)—one nasal, and one temporal. Viewed monocularly these components may be said to be equal.

The field of view represents the area on the stereogram which can be perceived by the eye. It is obvious from a cursory inspection of Fig. 11 that as we bring the chart nearer to the eye, the area or field of view becomes proportionately less, even though the angle remains the same. The area may be represented as varying directly as the square of the distance from the eyes. For example, if at a distance of 10 cm. the area perceived be 9 sq. cm., then at a distance of 20 cm. it would be 36 sq. cm. From the standpoint of stereoscope diagnosis and precision, we are concerned with the linear range of view, or the distance between the lateral margins of the halved stereograms. By multiplying the two adjacent lengths we ascertain the field of view.

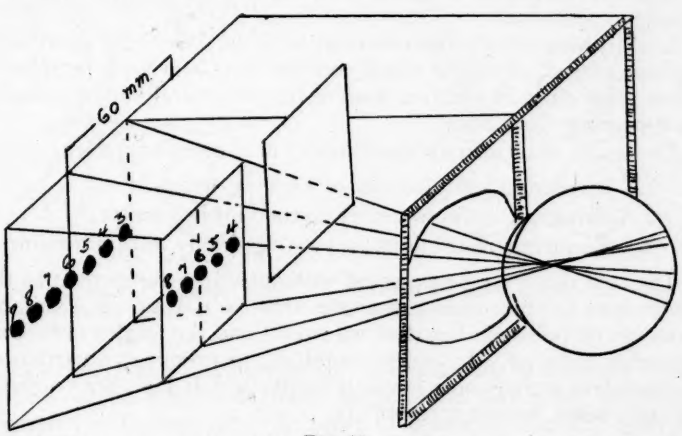


FIG. 11.

Angle of view in relation to field of view

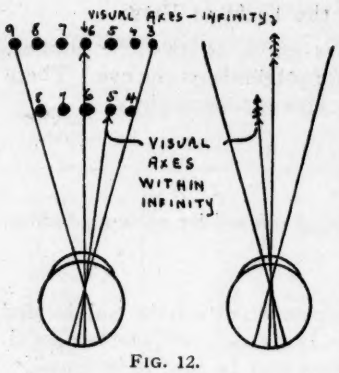


FIG. 12.

Visual axes in relation to angle of view. At the infinity range for viewing lenses we should, in normal orthophoric state, expect the eyes to be in primary position—and with the Wells B2 chart to select the ball to correspond to such a normal state—in this instance, the No. 6 ball.

Within infinity range, the visual axes converge, and the orthophoric will select a smaller number ball corresponding to a lesser separation of these axes, in this case the No. 5 ball. We here observe two things:

First—The convergence of the visual axes bisects the stereogram into two unequal portions—a smaller nasal and a larger temporal. This is important in realizing that as we converge, the relative range of active convergence becomes less and less in proportion to the range of divergence.

Second—It serves to remind us that the field of view becomes progressively less as the viewing distance becomes less. On the other hand, this increasing limitation in lateral displacement is compensated for by the greater prismatic value of unit deviation with proximity.

The relation between the angle of view and the visual axis may be further clarified by referring to Figs. 11 and 12. In viewing a stereogram monocularly, if the subject selects the No. 6 ball (Wells B2) as the centre of the halved stereogram, that ball should normally remain centralized, however, we move the chart back or forth. When viewed binocularly the viewing angles as well as the visual axes appear to converge.

We can readily prove to our satisfaction that the field of view lessens with increasing proximity to the eyes by the following simple experiment:

Look through the stereoscope at, say, the Wells B2 chart with one eye closed, and note which number ball is at each periphery. Then draw chart closer and observe the peripheral balls gradually disappearing from view.

The angle of view (with stereoscope) may be enlarged by:

1. Increasing the diameter of viewing lenses.
2. Bringing the eyes nearer to the viewing lenses.
3. Reducing restrictions in viewing frame to a minimum.

The best that may be expected with such an arrangement as the above is to produce enlarged angles that overlap unless a suitable partition be inserted; but then we would find the angles to be considerably reduced. In order, therefore, to produce two enlarged independent stereoscopic viewing angles which shall not encroach on each other, we must resort to:

1. Insertion of base-out prisms (equivalent to decentering spheres outwards)—Fig. 13. With increasing prism strength, the

FIG. 13.—Showing method of increasing angle of view.

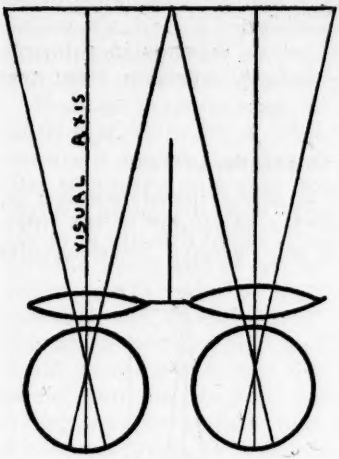


FIG. 13A.

Simple non-prismatic stereoscope. Visual axes parallel—small angle of view.

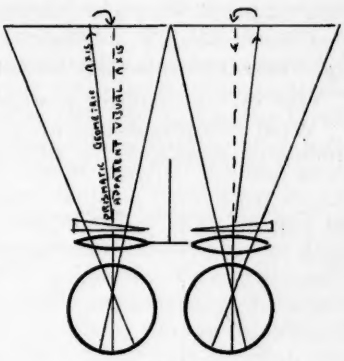


FIG. 13C.

By means of base-out prisms (or decentered spheres).

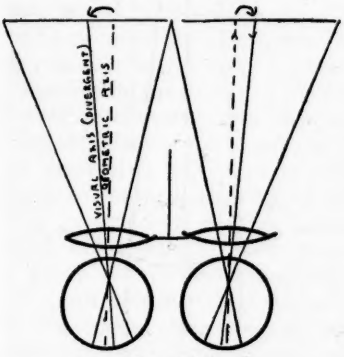


FIG. 13B.

Simple stereoscope — visual axes divergent—larger angle of view—impractical

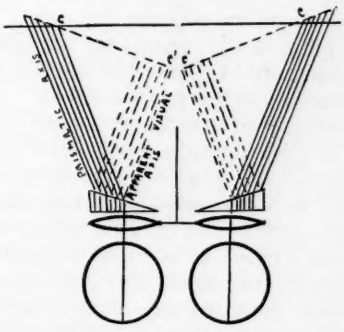


FIG. 13D.

Effect of too strong base-out prisms—distortion.

angle of view may be progressively increased up to a certain limit, beyond which further increase leads to an annoying prismatic distortion as in Fig. 13D. In order to utilize successfully such an increasing angle, the reflecting principle must be employed through such means as:

2. The Pulfrich-Zeiss Reflecting Stereoscope—in which specially ground rhomboid prisms are used to view large prints through double reflection of the rays, or by,

3. The Wheatstone Stereoscope—which depends in principle on the viewing of large pictures through reflection from two mirrors set at 45° to the prints.

(*g*) INTERPUPILLARY *vs.* INTERLENTICULAR SEPARATION.

One of the disturbing questions in using the stereoscope is, "What corrections should be made for variations in the inter-pupillary separation in relation to any selected interlenticular

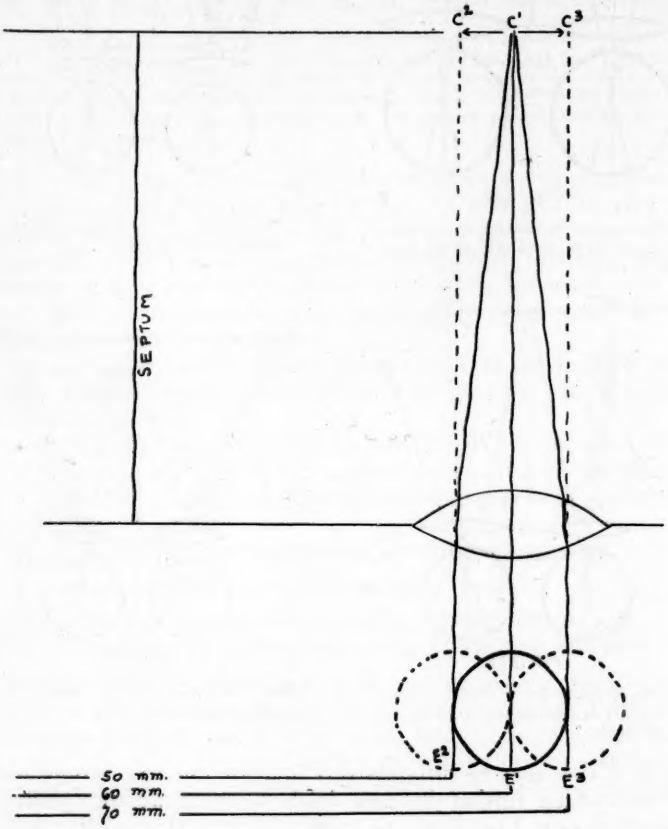


FIG. 14.

Showing relation between pupillary and lenticular separation.

separation?" A little reflection will assure the examiner that no attention need be paid to pupillary separation, but only to the interlenticular separation reading. A little study of Fig. 14 will help to explain why the pupillary reading is of no importance for purposes of stereoscopic study.

If we set the stereoscope to correspond to a pupillary separation of 60 mm. as in E^1, it is readily conceivable that the visual axes assume a straight continuous course to strike the chart centre C^1. But supposing with this stereoscopic arrangement we examine a subject whose pupillary separation is less, say 50 mm. as in E^2, the eyes will still prefer an inter-stereogram separation of 60 mm. and the visual axis of one will still remain parallel with that of its fellow eye in order to see the chart centre C^1 projected to C^2. Another way of expressing this compensating effect caused by this decentration of the viewing lenses would be to state that if we could conceive of a lens that had no prismatic effect in its peripheral portions, then the more narrowly separated eye E^2 would diverge in order to fuse chart centre C^1, but by the interposition of a base-out prism, as in decentering the viewing lens outward, this divergent eye is made straight so as to require no effort to see chart centre C^1 projected straight ahead to C^2. In the same way, the more widely separated eye E^3 would converge in order to fuse chart centre C^1 unless a base-in prism of sufficient strength were interposed to neutralize this convergent effect and cause its image to be projected straight ahead to C^3. So that *whether we are dealing with a narrower or a wider pupillary separation, the eyes will remain straight provided the interlenticular separation corresponds to the inter-stereogram separation.* Any truly divergent or convergent effect of the eyes from the primary position will be induced by disturbing this lens-chart relationship (visual vergence points), such as through shifting of split charts or by adding prisms to that required to disturb ocular equilibrium. This leads us to think of a prismatic stereoscope not necessarily as one containing a prism but of one containing sufficient prism or its equivalent (through shifting of pictures) to upset the calculated parallelism of the visual axes for far, or its calibrated convergences with changing accommodations. And vice versa, it leads us to think of a simple stereoscope as one containing sufficient sphere or sphero-prism (as in decentration) to maintain such parallelism of the visual axes for infinity. Contrary to supposed notions, therefore, a Holmes stereoscope or the American Telebinocular, with its fixed stereograms, does not produce a convergent effect because of its decentered spheres (or equivalent added prisms) but merely serves to adapt them to pictures that are more widely separated than the average pupillary diameter.

For those who wish to think in terms of figures in order to clarify

this problem, let us insert, for example, plus 5 D. spheres in viewer, as in Fig. 8 which is calculated for an interlenticular separation of 60 mm. Given a subject with a pupillary separation of 50 mm., it is readily conceivable that such a combined decentration of 10 mm. for plus 5 D. spheres would be equivalent to a base-out prism of 5 dioptres, and by referring to Col. 5, we readily note that at infinity range (20 cm.) 5 prism dioptres would displace the visual axes medially by 5 x 2 or 10 mm. so as to make an interstereogram separation of 60 mm. appear best for that pupillary separation wearing decentered spheres. In the same way, we can prove to our satisfaction that for any range of accommodation such variations in pupillary separation have no bearing whatsoever on the lenticular separation provided the latter is determined in relation to its visual vergence or primary position points on the stereogram for the particular accommodative range chosen.

(*h*) APPARATUS CONVERGENCE.

One of the major criticisms to stereoscopic investigation has been what some have termed apparatus or psychic convergence to indicate an inevitable tendency to convergence with the stereoscope even though accommodation be completely relaxed with suitable plus spheres. And so, phoria readings obtained with the stereoscope have been discounted by some because they were made at such a close range.

Without involving myself in the question as to whether such a reading is or is not correct, we must admit that the accepted practice of determining phoria by inducing an amblyopia in one eye (with red glass) also cannot be proved to be thoroughly reliable. Whatever the merits of such a phoria reading with the stereoscope may be, the author is satisfied that apparatus proximity does not explain " apparatus convergence." This fact may be readily proved by respectively inserting lenses of long and short focal lengths in the viewer, and making readings at the same accommodative range, say at infinity. Whether the viewing distance be long or short, the phoria readings at the infinity planes of the respective viewing lenses will be the same.

If comparative studies be made of lateral phorias with the red glass and prism method, and then with the stereoscope, there will be differences in the phoria readings. Some instances of exophoria will register esophoria with the stereoscope; and vice versa, in fewer instances, cases of esophoria will indicate exophoria with the stereoscope. We cannot prove that such variations indicate error in one or the other method, but merely serve to show that apparatus or psychic convergence does not tell the story. It would be preferable to speak of stereoscopic esophoria or stereoscopic exophoria.

In one method, the phoria readings are determined in relation to a point source of light which is artificially broken into two lights; in another, both eyes are made to function independently through the interposition of a septum.

The phoria readings made with the stereoscope are sufficiently constant to serve as a basis for subsequent comparative studies. Phoria readings in themselves have not proved as significant to the author as duction readings; for by whatever method one employs, a good phoria with poor duction (either abduction or adduction) is far worse than a poor phoria with good duction.

And finally, apparatus convergence would suggest that the range of abduction obtained with the stereoscope or synoptophore would be distinctly less than with the prism divergence method. As a matter of fact, it compares quite favourably with any of the older routine methods.

Author's Phorometric Stereoscope

In describing this modified type of stereoscope, the writer is quite mindful of the splendid progress made in orthoptic instruments in recent years, especially in England. These developments in precision machines appear to have been confined to improving the amblyoscope rather than the stereoscope. And so we have the elaborate synoptophore, with its Maddox accommodative convergence test attachment which may be expected to perform admirably. The element of precision does not seem to have invaded in like manner the interpretation of stereoscopic readings. I have been at a loss in aiming to answer for myself such questions as I have advanced in the previous chapter (under Problems in Computation). Some of the questions may be enumerated as follows:

1. What interpretation are we to make with stereoscopic readings?
2. Can we translate the linear separation between charts at variable ranges with changing accommodations in terms of prism dioptres of convergence or divergence?
3. Can we measure the fusion reserve at any particular range with any fair degree of accuracy with the aid of the stereoscope?
4. Can we record with an improved stereoscope the visual status of an amblyopic eye, and determine from subsequent examinations the amount of improvement in that eye?
5. Can we determine the presence and amount of convergence excess and insufficiency; and divergence excess and insufficiency with the stereoscope?
6. Can we record the findings with a stereoscope as a basis of determining progress in the individual case?

Practically all these problems may be solved with the complete synoptophore, but in favour of an improved stereoscope there are:—

(*a*) Simplicity of construction.

(*b*) Dispenses with the use of auxiliary lenses for determining fusional status and fusional reserve at any desired accommodative range.

(*c*) Accommodation convergence may be varied at will by merely varying viewing distance; also the infinity plane may be varied at will by inserting lenses of desired focal length.

(*d*) Not only may transparencies be used, but also opaque paper prints, photographs, and solid objects. Moreover, by the use of adapters, different sizes of transparencies or opaque prints may be employed.

(*e*) Offers the examiner a more ideal method for prescribing home training exercises with the stereoscope.

For excessive degrees of squint, the synoptophore may be expected to serve better, for there is a limit to the strength of prism that may be incorporated in the sterescope without causing distortion.

While the ordinary stereoscope may be depended upon to serve the purposes of a home-training instrument, there is no element of precision in recording the status of the eyes before or after exercises. And the so-called professional stereoscope is but a glorified home-training stereoscope.

Rather than describe the detailed mechanical features of my stereoscope, it may be better to distinguish it from the already familiar Brewster or Holmes stereoscope to which it is as intimately related as the synoptophore is to Worth's original amblyoscope:

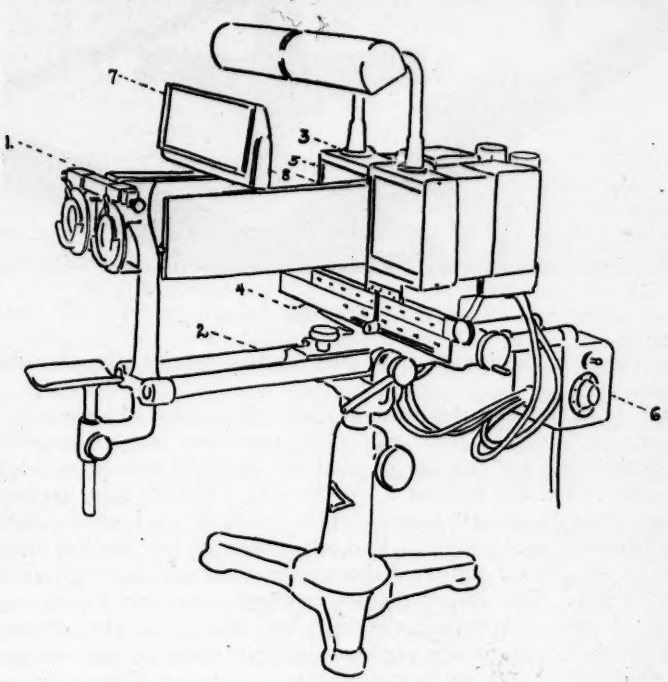
1. The viewing head of the familiar stereoscope has been replaced by a simple, sturdy trial frame with compartments for two sets of trial lenses as well as multiple spring-holders for the *free insertion* of *supplementary square prisms*. This frame may be readily adjustable to a *lenticular separation* that *could be varied* from 52 mm. to 90 mm. so as to be made to correspond to equivalent selective separations of the viewing boxes. The *lens holders are calibrated* to permit the study of plus or minus cyclophoria, as well as to indicate the position of a cylinder when an *ametropic correction* be *added in the frame*.

2. The connecting rod between the viewing boxes and the viewing head has been marked off in centimetres, and not in accommodation equivalents, so that the *examiner* may feel *free to employ whatever strength lenses he chooses* in the trial frame. The viewing distance may be readily varied by a rack and pinion screw

from 12 cm. to 40 cm. so as to permit flexibility in the choice of lenses for different requirements.

3. The viewing boxes or carriers are designed to receive *transparencies* and *solid objects as well as opaque prints*. Whereas in the familiar stereoscope fixed stereograms are in the main relied upon, in my instrument I employ split pictures which permit *flexibility in movement and control* in operation through a two-way thread device which shifts both boxes simultaneously by turning a handle which is conveniently placed within reach. The thread chosen is such that each complete turn of the handle moves each picture through a distance of 1 mm. Thus the operator is saved frequent inspections of the viewing scale.

4. For purposes of precision, the *position and lateral movements* of the split pictures or objects *may be readily noted* by means of an adjustable pointer which intersects two millimetre-rules: one that is fixed; and an upper one that moves with the movement of the boxes after its " O " position is set for the centre or selective point of whatever size picture is employed. *For testing vertical phorias and ductions, suitable adapters* may be readily



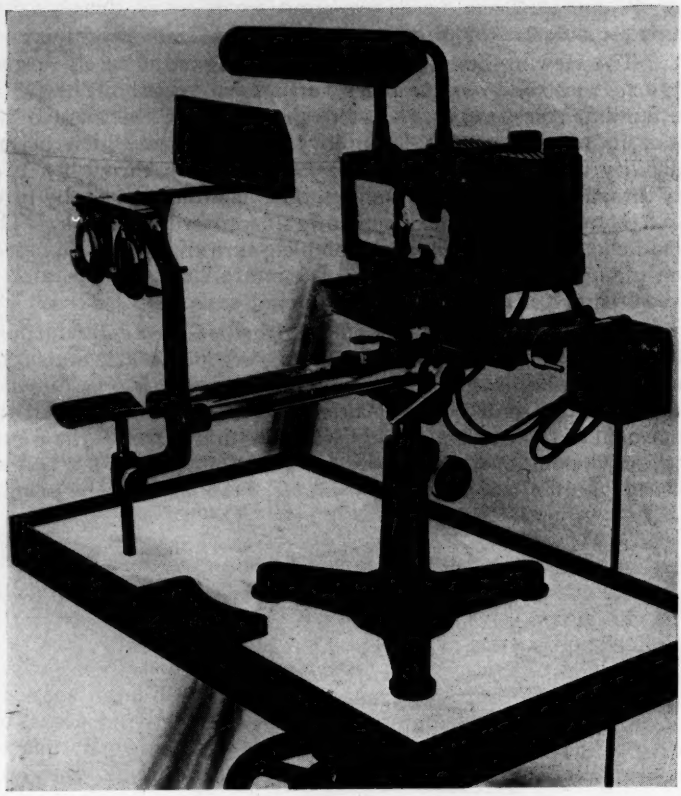


FIG. 15.

inserted and manipulated in relation to laterally placed vertical rules.

5. It offers both the examiner and his patient a *variety in the choice of stereoscopic material.* Due provision for pictures of five different sizes by the use of suitable adapters has been made—45×45 mm.; 60×60 mm.; 75×75 mm.; 82×82 mm. (synoptophore slides); as well as an adapter which holds both the Sattler and Guibor split charts. The advantage of the smaller picture lies in its greater range of movement for both convergence and divergence. The larger picture is more appealing for its wider field of view. Moreover, the first three sizes were also chosen to correspond to the more popular-sized stereoscopic cameras so as to enable the examiner to make his own pictures, if he so desires.

6. Each picture is illuminated by an independent lighting unit which operates both the lamp on the top of the viewing for opaque prints as well as the lamp within the box for transparencies. By a simple turn of a switch the *light may be shifted* to one or to the other.

7. One of the shortcomings in most eye examining or training instruments has been that the doctor cannot see the patient's eyes follow the shifting of the pictures. This difficulty has been overcome in my instrument by the incorporation of a *tilted mirror*, whereby *inspection of the patient's eyes* can be made without the patient being conscious that he is being watched. It also obviates unnecessary manipulations by the examiner who faces both the mirror and the viewing boxes with its calibrations.

8. *A collapsible, automatically operating septum* consisting of two opaque cloth curtains extend forward from respective rollers behind each viewing box to be attached to the viewing frame and, at the same time, hug these carriers in such a manner as to guard against the leakage of stray light when separated. This septum may be released from its attachment when desired so as to enable the examiner to insert a *stereo-campimetric attachment* in a specially designed groove in front of the viewing boxes.

9. Appreciating the importance of recording the state of visual acuity in the presence of amblyopia, the author offers the suggestion of supplementing and even incorporating a photo-electric cell unit with the stereoscope, so that metre-readings may guide the observer in recording the condition of the eyes at successive sittings. The importance of such a unit may be understood when we realize that the brilliancy of any lamp does not remain constant; and that the density (light-transmitting or light-reflecting properties) of prints and transparencies vary within wide limits.

As to the deductions to be made with the photo-electric cell, the author has not yet carried out any experiments in relation to the stereoscope, but nevertheless feels convinced as to its ultimate value because of its successful application in collateral fields. For the present, however, we may state that with such an added feature we may wish to determine the minimal brightness required for the subject to note the details of a halved stereogram (as in amblyopia), and to record the metre-reading as the status of visual acuity at that sitting.

One of the shortcomings of the ordinary stereoscope is that it is not suitably adapted to excessive degrees of squint. Such a defect may be corrected to a considerable extent by removing all unnecessary barriers in the viewing frame, by providing a more flexible range to the viewing distance, and by the use of selective lenses in the viewer. Inasmuch as the unit displacement of the visual axis registers a greater prismatic effect for near, we may

adapt the stereoscope to more marked degrees of convergent squint with either lenses of short focal length (stronger plus lenses) for infinity, or lenses of longer focal length for accommodative ranges. If, for example, we choose plus 8 D. spheres in viewer for infinity range (12·5 cm.), the maximum convergence for far which could be accommodated at that range without the use of supplementary prisms would be equivalent to more than 60 prism dioptres. On the other hand, divergence could be carried to a considerably greater extent without the use of supplementary prisms.

Plan of Stereoscopic Investigation with a Phorometric Stereoscope

While a stereoscopic study *per se* can yield valuable information as to the binocular status of the eyes, a preliminary refractive. ocular, and routine muscle study will prove indispensable in evaluating the entire picture. A suggested procedure is as follows:

1. History—rule out hereditary factors; birth injuries; poliomyelitis; diphtheria; whooping cough; encephalitis; syphilis; previous operations; age of onset; general health; muscle exercises; headaches—worse for near work or far; blurring of vision; ocular pains; diplopia; head-tilting.
2. Vision—with and without glasses, including ametropic correction (note with or without cycloplegic).
3. Routine study of eyeball proper.
4. Introductory study of muscles.

(*a*) *Do eyes appear straight or crossed?* A screen or cover test usually done both at 20 feet and at 13 inches respectively will tell us whether the eyes remain stationary or move out (esophoria or -tropia) or in (exophoria or -tropia) when the cover is removed. If the eyes remain motionless in spite of an apparent deviation they would suggest a positive angle alpha if they gave the appearance of a divergence, and a negative angle alpha if they gave the appearance of a convergence. In either instance, the details are recorded, as well as noting whether the excursion on removal of the cover is slight or considerable. By such a record, the check up with the stereoscopic approach becomes more fascinating. The neutralization of the ocular movements by means of prisms as part of the screen test are not so essential and can be determined much more easily under the calibrated stereoscope.

(*b*) *If a squint is present, which is the fixing eye and which the squinting eye? Is the squint alternating or monocular, constant or periodic, intermittent or continuous?*

(*c*) If there is a true deviation, *what is the approximate measure in degrees?* The Hirschberg reflex method has appeared fairly satisfactory, although crude.

(*d*) Do the eyes converge well for near? *What is the near point of convergence?* There is no uniform method for determining the near point. Whatever method be employed, the author has found it more satisfactory for the subject to follow his own finger than a pencil or other material object, for instinctively it seems to hold the attention of the patient better.

(*e*) *Do the eyes move equally in the four oblique positions of gaze as well as to the right or left?* If there is a lagging or spasm of either eye in any of these six cardinal fields, what muscle appears to be at fault? For this, the time-honoured methods are resorted to.

For the study of the vertical phorias and vertical ductions, both for far and near, the author finds the stereoscope sufficiently dependable and convenient and precise to dispense with the usual clumsy method of inducing a diplopia with base-in prisms. In the same way, horizontal ductions determined by the familiar prism divergence (abduction) or prism convergence (adducton) tests are dispensed with because they can be measured far more satisfactorily with a calibrated stereoscope or synoptophore.

Before conducting operations with a phorometric or calibrated stereoscope, the examiner should decide upon:

(*a*) *What strength viewing lenses to select*—For cases suggesting a convergence excess (in-turning for near), lenses of long focal length operated at any selective accommodative range are preferable. For cases pointing to divergence insufficiency (in-turning for far), lenses of shorter focal length such as plus 6 D. or plus 8 D. adjusted to their respective infinity viewing distances are more desirable.

(*b*) *The Interlenticular Separation*—When a case suggests an in-turning of the eyes, a wider lenticular separation of, say, 80 mm. lends itself to greater degrees of convergence than one of lesser lenticular separation. For such an 80 mm. separation (40 mm. reading on lens frame), the corresponding setting of the split chart at 40 mm. on fixed rule (from septum) yields a primary position reading for infinity as a starting point for the medial shifting of pictures in the adduction phase, and for the lateral shifting in the abduction phase. If a uniform 60 mm. lenticular separation be employed it may necessitate the addition of more supplementary prisms (base-out) to correspond to the added convergence which would otherwise be effected by decentering the spheres outward.

(*c*) *Viewing Distances*—These depend upon the strength of lenses selected as well as upon the accommodative ranges at which we intend to carry out our tests.

For our introductory study of stereoscopic technique we *may*, for the present, *discount the above refinements* and *confine* our attention *to* the *more simple operations* of the instrument on the basis of the three afore-mentioned visual vergence charts calibrated for a lenticular separation of 60 mm.

For purposes of practical and ready investigation, Visual Vergence Chart No. 1 (using plus 3 D. spheres) may be reconstructed as follows:—

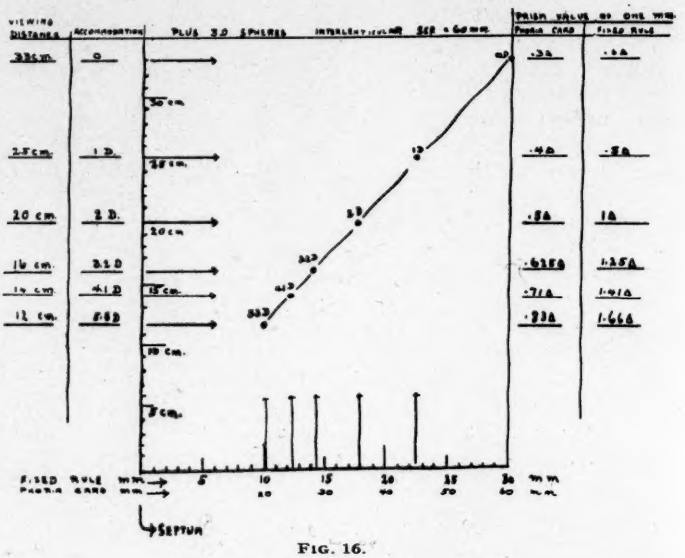


FIG. 16.

Reconstructed Visual Vergence Charts.

In the same way, the other visual vergence charts may be rearranged for ready reference.

With an elastic stereoscope which permits the free choice as well as separation of the viewing lenses, as well as calibrated shifting of the charts, a set of ready-reference cards may provide added interest and scope to our studies. Such charts may be readily calculated according to afore-mentioned directions for separations of 60 mm., 70 mm., and 80 mm. respectively; as well as for lenses of from plus 1 or 2 D. to plus 8 D. respectively. The author's stereoscope may, if desired, be used for accommodations as high as 8·5 D. without lenses in viewer, and for correspondingly lesser accommodations with spheres of gradually increasing strength.

With the above charts graphically illustrated, the examiner may next proceed to apply it to the particular problems which he wishes to solve. These may be listed in the form of questions as follows:

(*a*) *If the eyes are crossed, what is the apparent lateral deviation?* The patient fixes a black dot placed in one viewing box. The image of a narrow vertical luminous slit from the other carrier is made to centre on the cornea of the other eye, and reading is then made. Such test is then repeated with the opposite eye fixing the black dot, and the light slit shifted to the fellow eye. The tilted mirror proves indispensable in following the ocular movements.

(*b*) *Is there simultaneous perception of dissimilar pictures, or of those in which no fusion element is possible? Is the simultaneous perception macular or extra-macular?* Is there suspension or suppression? In cases of squint, unless marked, simultaneous perception is quite possible, but the images are projected falsely or extra-macularly.

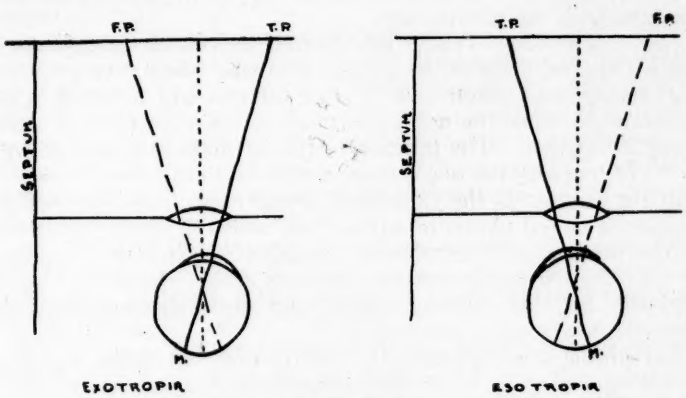


FIG. 17.

Showing false projection in relation to stereoscope.

F.P. = False Projection. T.P. = True Projection or True Deviation. M. = Macula.

In cases of convergent squint, the images will be projected laterally (or homonymously) in relation to the actual deviation of the visual axes; in divergent squint, the images will be seen medially (or crossed).

(*c*) *Is there false or extra-macular projection?* For this test, two dissimilar small sources of light, such as a rounded hole from one carrier, and a lighted cross from the other are selected. After the subject has "fused" or approximated these two sources of light, the lights are alternately flashed, and the patient made to fix first the hole, and then the cross. If motion takes place in this alternate fixation, the projection is false. If the eye turns out to

see the corresponding image there is an esotropia, and the boxes are approximated until alternate flashing and fixation produces stopping of ocular excursion. The rule setting at which such motion stops tells us the amount of true projection or deviation. Here too, with the aid of the tilted mirror, the fine movements of the eyes may be clearly observed by the examiner.

(*d*) *What is the lateral phoria for far and for near?* In the afore-mentioned theoretical discussion, while the ruled lateral phoria card may be used to test lateral phorias both at infinity and for any selective accommodations, it can hardly hold the attention of the young child who requires a more fascinating and simpler method of approach. With the author's stereoscope and its shifting mechanical arrangement lateral phoria may be tested by the use of two pictures or objects in which no fusion element is possible, and with results that are quite comparable to that obtained with the phoria card.

The " Two-Dog Test " has proved especially gratifying in holding the attention of the young child who looks at two wooden dogs facing each other—one in each carrier—and is asked to tell the examiner when the noses just touch as these boxes are steadily brought together. The position of the movable or slide rule with its " O " beneath the dog's nose in relation to the lower fixed rule with the pointer at the calculated primary position indicates the amount of lateral phoria in millimetres, which is readily translated into prism dioptres of esophoria or exophoria. This test is repeated for any desired accommodative viewing range, the pointer again adjusted, for that viewing range, and the displacement of the movable rule is again interpreted.

For phoria readings with the phoria card, we make our computations according to the visual vergence chart we select.

(*e*) *What is the range of adduction and of abduction for far and for near? What is the amplitude of fusion?* If we can conceive of adduction as that amount of medial displacement of the split pictures from their primary setting without disturbing single binocular vision; or of abduction as the lateral displacement from the primary position, we can readily understand that the added value of these two displacements is the amplitude or range of fusion. The only additional point to bear in mind is that the primary position (or visual vergence point) does not remain stationary but shifts with changing accommodations.

For testing at infinity, adjust viewing distance and set pointer accordingly. Inasmuch as the range of fusion consists of two phases—adduction and abduction—we first aim to obtain the adduction reading by shifting the pictures medially from their primary setting, and supplementing, if necessary, by the addition of base-out prisms until diplopia results. The pictures are then

returned to the primary position from which we gradually and slowly shift the pictures laterally until there is another " break " in the image. This is our abduction reading in millimetres as measured by the displacement of the slide rule with its " O " beneath the chart centre in relation to the fixed rule with its pointer set at the primary position. Such reading is readily translated into prismatic equivalents by referring to the column at the right in Fig. 16.

For testing at any selective accommodative range, say at 3 dioptres, we set the pointer for that accommodation as outlined in Fig. 16 and repeat our operations both medially and laterally from this altered primary position.

(*f*) *Is there hyperphoria for far or for near*? The vertical phoria card is helpful, and displacements from the horizontal " O " can be readily translated in terms of prism dioptres of right or left hyperphoria.

In the author's instrument, with the aid of a vertically shifting adapter, it is possible to test vertical displacement of the eyes in hyperphoria and hypertropia both objectively by observing the alternate vertical movements of the eyes with the use of horizontal luminous slits in response to alternate flashing, or subjectively by having the patient level two horizontal lines or slits, and noting displacements, if any, on laterally placed rules. Here too, the tilted mirror proves very helpful.

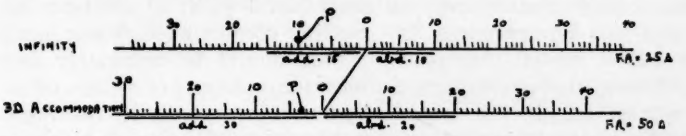
(*g*) *What is the range of vertical duction for far and for near*? With a vertical adapter, the range through which two pictures can be made to maintain single binocular vision when shifted vertically is obtained.

(*h*) *What is the measurement of cyclophoria, if any, for near or far*? The lens frames are calibrated as shown in the illustration to permit the testing of plus and minus cyclophoria with the use of Maddox rods.

(*i*) *What is the range of cycloducton*? With the use of a calibrated revolving adapter for split pictures, minus and plus cycloduction may be recorded both for far and near.

(*j*) *What is the status of binocular vision*? This depends on the results of the above tests as well as the added testing with Grade 2 and Grade 3 stereoscopic slides.

For rapid charting, we may plot our readings as follows:



P. = Phoria point. Add. = Adduction. Abd. = Abduction, F.A. = Fusion amplitude. F.P. = False projection. T.P. = True projection or deviation. C.R. = Corneal reflex.

The additional aforementioned tests are not so easily plotted on such a record card, and may therefore be summarized as the examiner sees fit.

The above record refers to a more simple type of case in which at infinity range there is an esophoria of 10 prism dioptres; adduction is 15 dioptres; and abduction, 10 dioptres—making a total of 25 prism dioptres for far. At the 3-dioptre accommodative viewing range, there is an esophoria of 3 prism dioptres in relation to the shifted primary position for that range; the adduction power is 30 dioptres; and the abduction, 20 dioptres, making a total fusion amplitude of 50 prism dioptres for near. The examiner notes at the left hand margin the particular accommodative range he has selected for his readings.

The rulings on this record card indicate fusion status in terms of prism dioptres rather than in units of length, and may therefore be applied to any of the tables used; for, in the final analysis, no matter what lenses we employ, we are interested in the prismatic equivalents of the readings made.

The Stereoscope in Orthoptic Training

It has been established that the vergence readings (or the visual axes displacement) change with changing accommodations. In order, therefore, to determine the existence or the degree of muscle anomaly, we should first ascertain the normal vergence readings for the particular range of operation. Whatever the disturbances may be, the obvious aim is to train the eyes to fuse an inter-stereogram separation corresponding to the normal calculated vergence readings. Depending on the type of case with which we are dealing, it may mean a gradual lessening of this distance in one case; or a lengthening, if there be an excessive convergence tendency. To be more specific, let us aim to adapt the stereoscope to four well-defined muscle anomalies, as follows:—

1. CONVERGENCE EXCESS. (ESOPHORIA OR ESOTROPIA FOR NEAR).

Operate the stereoscope in the accommodative range. If plus 3 D. lenses are used at a distance of 16 cm., 3 dioptres of accommodational convergence are normally brought into play which according to visual vergence chart No. 1 (Col. 6) displaces each visual axis 15 mm. medially. So that convergence excess implies an added medial displacement that should be accurately noted according to aforementioned directions. After noting the convergence status, proceed very slowly and interruptedly by turning the handle so as to separate these two pictures, always aiming to maintain fusion. If there be a sudden break, approximate the

pictures, and start over again. Note the maximum amount of separation attained at that sitting, and translate this reading in terms of prism dioptres. Before instituting exercises, correct refractive disturbance. If hyperopia, fully correct; if myopia, undercorrect.

2. CONVERGENCE INSUFFICIENCY. (EXOPHORIA OR EXOTROPIA FOR NEAR).

First correct refractive disturbance—if myopia, fully correct; if hyperopia, undercorrect.

Operate stereoscope in the accommodative range, as above. After noting convergence deficiency status, proceed very slowly but in the reverse direction (from convergence excess), and gradually aim to train the eyes to fuse more closely separated pictures; also noting the optimal (least) separation attained at that sitting.

3. DIVERGENCE EXCESS. (EXOPHORIA OR EXOTROPIA FOR FAR).

If myopia, fully correct; if hyperopic, undercorrect.

Set the stereoscope for infinity range; then separate pictures beyond range of divergence, if possible and note on rule the limit of fusion in the divergence range. Then gradually bring the pictures together, and note the optimal (least) separation attained.

4. DIVERGENCE INSUFFICIENCY. (ESOPHORIA OR ESOTROPIA FOR FAR).

Set stereoscope for infinity range.

Exercise eyes to fuse increasingly separated pictures, each time noting the initial (least) and optimal (maximum) separations.

For supplementing home training with the stereoscope, the following details should be explained to the patient at each examination :—

1. Viewing distance—depending on muscle anomaly (as above).
2. Initial and optimal separations of charts to be measured with a millimetre rule and governed by findings of examiner.
3. Length and frequency of exercises-arbitrary.
4. Type of training material—for excessive convergences, the narrower separation limits the size of material.

5. Illumination of fusion material—being stronger for amblyopic eye.

6. Exercises should be carried out under refractive correction. A daily record by the patient should prove more interesting and valuable to both himself and to the examiner. The following is suggestive:—

DATE	VIEWING DISTANCE	TRAINING MATERIAL	INITIAL SEPARATION	OPTIMAL SEPARATION

Concluding Remarks

1. Stereoscopy, as ordinarily practised, is a vague undignified technique.

2. An appreciation of the underlying principles of stereoscopic optics is imperative in interpreting stereoscopic manipulations.

3. A fixed stereogram (with exception of a phoria card) is an unsatisfactory method of determining the fusion status or for orthoptic training.

4. The eyes cannot maintain the same inter-stereogram separation with change in viewing distance.

5. As the eyes converge with accommodation, the inter-stereogram separation must be made correspondingly less in order to maintain easy fusion.

6. A split stereogram which can be shifted to correspond to changing positions of visual axes with variable accommodations is the only practical method for stereoscopic study.

7. A stereogram with a separation fixed for infinity viewing range becomes relatively divergent when brought nearer to the eyes.

8. The variable convergences of the eyes with changing accommodations may be accurately calculated and applied to stereoscopic investigation.

9. A precision stereoscope enables the examiner to determine the convergence and divergence status in the primary phase both

at infinity and at any desired accommodative range; thus enabling the examiner to diagnose and to classify the type and degree of muscle anomaly; the range of fusion; the amount of phoria; and the progress in terms of prismatic vergence with each sitting.

10. The ordinary professional stereoscope, because of its cramped construction and lenses of fixed focal length, considerably reduces its adaptability to excessive convergence and divergence. The stereoscope, however, may be so modified as to be adaptable to fairly large degrees of ocular convergence by the use of widely separated lenses of selective short focal lengths and supplemented, if necessary, by suitable prisms.

11. Accurate records can be kept with a calibrated stereoscope, and further supplemented with the patient's home-training record for purposes of intelligent co-operation.

12. The incorporation of fixed base-out prisms, as in the ordinary stereoscope is not, as ordinarily supposed, a means of adapting the instrument to greater convergences—but a relic of bygone days for employing larger stereograms (greater field of view) for purposes of parlour entertainment. The addition of selective prisms should be left to the examiner who alone should be in a position to determine the need for supplementing base-in or base-out prisms.

13. The author's stereoscope enables the examiner to determine at a glance the amount of convergence or divergence, with selective accommodations, for fusing split pictures, by incorporating:—

(*a*) Viewing lenses of variable separation and of known focal length.

(*b*) Movable calibrated rod.

(*c*) Viewing boxes calibrated to record amount of separation of split pictures, and,

(*d*) Tables to which examiner may refer so as readily to translate these vergence readings.

TRACHOMA

(Note on some interesting features which appeared in connection with a combined research by various members of the Government Ophthalmic Hospital and the King Institute of Preventive Medicine, Madras, 1935-6)

BY

LIEUT.-COL. R. E. WRIGHT, C.I.E., I.M.S.

PROFESSOR OF OPHTHALMOLOGY, MADRAS

IN the *Brit. Jl. of Ophthal.* of June, 1935, I discussed in a general way some of the practical difficulties in connection with investigations into the aetiology of trachoma. In the same article an experimental advance was claimed in this connection, namely, the appearance of growths on the chorio-allantoic membrane of the chick when inoculated with unfiltered trachoma material. The possible value of the observation was hopefully alluded to, but those of us engaged in the research fully realised that it might prove sterile for various reasons apparent to any one familiar with experimental bacteriological work. Dr. C. G. Pandit conducted the laboratory aspect of the research and the detail of the combined work was published in the *Indian Journal of Medical Research* (Pandit, Wright, Sanjiva Rao, Satyanathan, October, 1935).

Briefly, our results indicated that material derived from the washed conjunctivae of persons suffering from clinical trachoma, when implanted on the chorio-allantoic membrane of the chick in the unfiltered condition produced growths which could be subpassaged and were sterile to ordinary laboratory media. A suspension of such growths did not reproduce the disease on the normal human conjunctiva. Trachoma material such as that used for the egg inoculations when implanted on the normal human conjunctiva reproduced trachoma seven times out of seven. The average incubation period was five days. The onset of the condition was sometimes acute, sometimes quiet and almost non-inflammatory. The conjunctival changes were always trachomatoid in nature. The limbal vascularisation was not constant. Sometimes the marginal capillary changes were no more than might be observed in keratitis due to various causes. There was a tendency to spontaneous recovery in most cases. They were dealt with by lavage with a minimum of trauma. Certain experiments suggested that heating the trachoma material to 120° F. for two minutes was detrimental to the infective agent.

In continuing the work in 1935-36 we planned to investigate the effect of filtering the trachoma material through collodion membranes prior to implantation on the chick. Before this could be

commenced Lt.-Col. H. E. Shortt, I.M.S., who assumed the Directorship of the King Institute of Preventive Medicine, Guindy, kindly offered his criticism and co-operation and shortly afterwards took up the direction of the laboratory aspect of the research. During the year the clinical investigation was concerned largely with testing the infectivity of filtered trachoma material. The laboratory aspect of the work was side-tracked since controls revealed that a variety of agents other than known viruses and unfiltered trachoma material produced similar chorio-allantoic growths with varying histopathological changes. Under the circumstances Col. Shortt found it necessary to institute an enquiry into the classification of the chorio-allantoic changes according to the nature of the irritant used and the histopathological effect produced.

At first sight this seemed to be the end of our original idea, that possibly a trachoma virus was responsible for the chorio-allantoic growths produced in 1934. It may be so, but until the whole question of the effect of different agents (organismal, chemical, mechanical, known virus, etc.), on the chorio-allantoic membrane of the chick is worked out, nothing further can be said as to the significance of the effects of inoculations with unfiltered,—but apparently bacteriologically sterile—trachoma material. This also applies to the fact that our most recent egg inoculations with trachoma material filtered through collodion membrane 1·8 μ a.p.d. gave growths which were successfully sub-passaged, when ground and filtered through similar membranes. The investigation into the chorio-allantoic reactions to irritants was pursued during 1936 in Col. Shortt's absence by Dr. C. G. Pandit, who agrees with me that a few words about this aspect of the work are permissible pending detailed publication.

It appeared that many such growths were what one might call epitheliomatoid in character in so far as the chorio-allantoic epiblast (?) is concerned showing marked proliferation, cell nest formation, etc. That whereas chemical and mechanical irritants produced growth-like tissue changes, these were not sub-passagable, whereas pure virus growths and certain organismal growths were, even in the latter case when the material used for sub-passage was ground and filtered through membranes a.p.d. 1·1 μ. This suggestion of mutation naturally stimulated renewed interest in our trachoma growths. The essential details of the laboratory and clinical work for 1935-36 will be published in due course in the *Indian Journal of Medical Research* under the rules of the Indian Research Fund Association which made a grant towards the investigation. Meantime it may be stated here in a general way that the clinical research work of 1935-36 appeared to support several aspects of the trachoma problem to which I have

previously drawn attention. In contrast to the 1934 findings it was noted that material from typical cases of trachoma does not always infect the normal human conjunctiva. This may be due to a number of causes, *e.g.*, because the material is non-infective, the dose is insufficient, etc. In certain cases there was no conjunctival response to known infective material possibly because the individual was resistent, the dose insufficient, etc. As yet there is not sufficient evidence to explain these observations. Such findings opened up new fallacies in connection with the clinical side of the research and made the control work very difficult. It is significant, but as yet of doubtful interpretation, that filtered trachoma material (1·8 μ a.p.d. collodion membrane), failed to infect the normal human conjunctiva in nine cases out of nine attempts. It is inevitable that in a research of this type the course of the investigation should be deflected to meet those difficulties as they become unmasked, the non-recognition of which would lead to fallacious conclusions. The deflection of the laboratory investigation has been stated above.

On the clinical side the fallacies which arose because certain cases of clinical trachoma (trachomatoid affections), do not transmit the disease—(whereas similar donors infect the same recipient) —may be partially got over by pooling the material collected from a number of apparently typical trachoma donors. I say partially, because it introduces a new fallacy, namely, dilution of a possible virus, which must be catered for by a concentration method. The fact that certain persons are apparently not susceptible to trachoma material known to be infective to others, raises a more serious problem, which demands separate investigation as regards individual and racial, acquired and natural aspects.

In this connection it may be noted that part of our experimental work published last year suggested that the serum of old healed trachoma cases had acquired certain properties of immunity. The tendency for the experimental disease is to recover spontaneously, provided the conjunctiva is not traumatised by unnecessary manipulations and the application of irritants, has its counterpart in routine out-patient work. The frequency with which one observes a uniformly scarred and healed conjunctival membrane, with a grey haze and occluded vessels in the upper part of the cornea, in perfectly quiet useful eyes, with a history of previous symptoms indicative of kerato-conjunctivitis which was not treated, is sufficiently significant. This is not meant to imply that the difference between the severe forms of trachoma, so familiar to all who deal with the disease, and the milder spontaneously healing forms, are determined by misdirected treatment; for experimental clinical work definitely shows that in certain cases the disease bursts forth in a fulminating manner and in others it starts

insidiously, and individuals vary in their response to the same infection. The difficulty of obtaining recipients makes controlled clinical investigation most tedious, but even a few definite data such as our clinical research has yielded make it worth the prolonged periods of observation demanded.

Apparently it is premature to assume and speak of the virus of trachoma, when filtration appears to protect the human conjunctiva from infection, even though chorio-allantoic growths resulting from filtered trachoma material may be sub-passaged when ground and filtered. The possibility of an agent with filterable and unfilterable stages must at least be considered. One must be very guarded about suggesting aetiological hypotheses on insufficient proof in such a problem, when, even the clinical criteria of the condition under investigation are not agreed upon amongst authorities. This fact deprives the figures collected and published in connection with trachoma of any real statistical value. It must be rare to find clinically an absolutely uncomplicated early trachoma and very difficult to make a positive diagnosis of such a condition. Mixed infections, environment and so on alter the clinical picture in the later stages. Even if we assume that certain apparently unmixed affections of the conjunctiva and cornea represent the disease " trachoma " *sui generis*, it is obvious that its aetiological agent is just as likely to fall into sub-groups as say some of the known pathogenic organisms, with presumably the production of a varying clinical picture. Should the agent be a virus this is perhaps more likely to be a feature. There has been a vast amount of new work on the trachoma problem in the past few years and in spite of a useful general advance some unjustifiable conclusions have been reached on insufficient evidence. It is essential that the research worker should guard against the acceptance of observations—his own or those of others—which favour a preconceived conclusion, as evidence, without confirmation. Morphological observations constitute poor evidence especially when dealing with such things as free elementary bodies. One ought to be less likely to fall into error when cultural and transmission methods are favoured, but as indicated above the difficulty in avoiding fallacies when trying to obtain evidence concerning the aetiological agent or agents in trachoma or the trachomatoid infections is enormous.

LYMPHOSARCOMA OF EYELID

BY

VIVIAN M. MÉTIVIER

TRINIDAD

ORBITAL tumours are considered rare; and sarcoma of the eyelid is a very rare growth. In an analysis, however, of 500 tumours among natives of Nigeria suffering from malignant disease, E. C. Smith and B. G. T. Elmes[1] found that 29, or 5·8 per cent., of the tumours examined occurred in children under ten years of age: and of these, no less than 10 were round-celled sarcomas of the orbit.

Smith and Elmes suggest that probably many of these growths had their origin in trauma, since injuries to the eye are notoriously common among the natives.

The next age group (10 to 30) included 57 tumours with the number of eye tumours diminished to 3, whereas tumours of the parotid increased to 13.

Under "Tumours of the Orbit," they state that the orbital growths comprised 18 sarcomas, 10 carcinomas, 1 endothelioma, and 1 cylindroma. With the exception of one melanotic growth, all the sarcomas were round-celled in type.

A photograph is shown of a patient as Fig. 5, a boy aged 12 years, with a round-cell sarcoma of six months' duration. It has the appearance of the tumour having started in the eyelid as in the case recorded below.

Friedenwald[2] illustrates a case of round-celled sarcoma of the eyelid with a photomicrograph. He finds that sarcoma of the conjunctiva is rare and exhibits no predilection for any special type.

Of 4,899 eye cases seen at the Colonial Hospital, San Fernando, from May 16, 1932, when the Eye Department was established, to the end of December, 1936, the following case is the only one of malignant disease of eyelid or orbit.

R.F., a Trinidad brown-skinned boy of impure African descent, was first seen as an out-patient on October 16, 1934. He was then 11 years of age.

The condition of his right upper eyelid then appeared to be that of a large neglected chalazion with granulation tissue protruding towards the lid margin. Arrangements were made for operative treatment, and it was then seen that, instead of a chalazion being present, a soft friable growth infiltrated the upper lid in its nasal

half well back towards the upper fornix, appearing on the conjunctival surface as a palish flat mass and bleeding readily.

The appearances were unusual and operation was postponed for admission to hospital. Unfortunately, the boy failed to return until December 11, 1934, when he reported at out-patients with the enormous lid enlargement shown in Fig. 1.

The globe of the right eye was then completely hidden. There were dilated veins on the oedematous skin surface and the whole

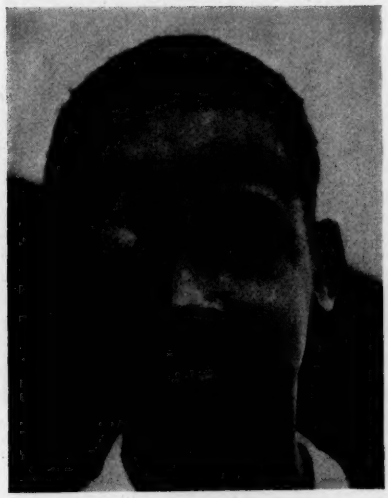


FIG. 1.

R.F., before operation. Photo taken December, 1934.

eyelid was greatly thickened, tense, and indurated. On December 14, 1934, his blood Wassermann reaction was reported to be strongly positive and it was then decided to give anti-syphilitic treatment for two weeks. There was no change as the result of intravenous N.A.B. together with Pot. Iodid. 21 grains a day. On the same day, December 14, portions of growth were removed for microscopic examination and were later on reported to be round-celled sarcoma by Dr. J. L. Pawan, M.B.E., Government Bacteriologist.

Under general anaesthesia the eyeball was seen to be free from involvement, but there was extension towards the subconjunctival tissue of the lower lid with invasion of the caruncle and plica.

Exenteration of the contents of the orbit was finally decided on with removal of both eyelids. The operation was performed on December 30, 1934. Healing took place without any complication; but skin grafting was delayed until February 22, 1935, by the development of an iodide rash with pustule formation.

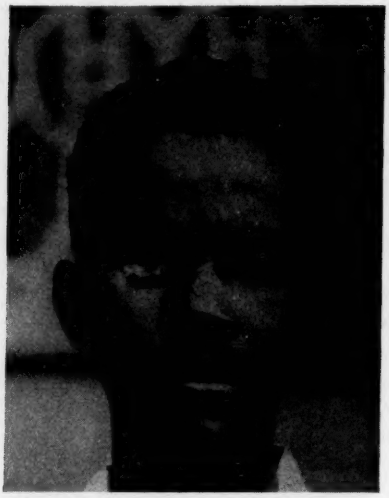


FIG. 2.

R.F., after exenteration of right orbit and skin graft. Photo taken June 11, 1935. Frowning due to mydriatic effect, left eye.

At the skin-grafting operation an enlarged gland was excised from the angle of the right jaw, and was reported to contain sarcomatous tissue similar to that found in the excised upper lid.

The dark appearance of the skin graft at the apex of the orbit can be seen in Fig. 2, which was taken on June 11, 1935. After the exenteration operation, anti-syphilitic treatment was continued until his discharge on March 15, 1935, to the care of the D.M.O., Dr. Jesse Grell.

On June 21, the blood Wassermann reaction was reported to be still strongly positive. There are no stigmata of congenital syphilis in this boy.

On October 4, 1935, an enlarged lymph node, found on the right side of his neck in the posterior triangle, was excised: but microscopic examination of it showed no signs of malignancy.

The boy remains well and in good health, with no evidence of recurrence. He was last seen by me on December 4, 1936. He has had two courses of treatment with N.A.B. and Bismuth in view of the repeatedly strongly positive W.R.

With Dr. Pawan's approval, and the consent of Dr. Wise, Surgeon-General, the exenterated orbital contents were sent by me to Dr. W. F. Harvey, Royal College of Physicians Laboratory, Edinburgh. Dr. Harvey has kindly given me permission to publish his report. It is as follows, and is dated May 4, 1935:

" Sections show: (1) What I consider to be, probably, a large round cell lymphosarcoma (reticulum cell sarcoma); (2) Very great

FIG. 3.

Photo of macroscopic section of whole transection of eyeball and lids, showing growth in lids.

cellularity; (3) Numerous mitoses; (4) No connection with the surface epithelium of either eyelid or conjunctiva; (5) Fairly large nucleus and eosinophilic cytoplasm; (6) No sign of any rosette or pseudorosette formation; (7) No indication of melanoblasts or melanophores, and (8) Restriction of growth to upper and lower lid. Complete freedom of the eyeball from tumour. I have considered the various probabilities here of epithelial tumour, neural tumour and especially the neurocytoma of the adrenal, melanoma, and glioma, and have come by a process of exclusion to the above diagnosis. But the tumour is a peculiar one. The presence of the same tumour in the lymph node at the angle of the jaw is somewhat confirmatory."

The macroscopic section shown in Fig. 3 is a whole transection of eyeball and lids prepared by Dr. Harvey. One half of the specimen was sent to the Royal College of Surgeons Museum, Edinburgh, and was gratefully accepted by the late Mr. David Greig, Curator of the Museum.

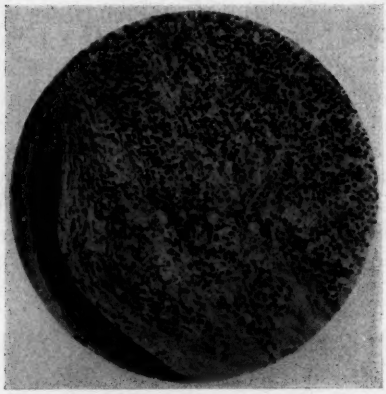


FIG. 4.

R.F., lymphosarcoma of eyelid. (×100)

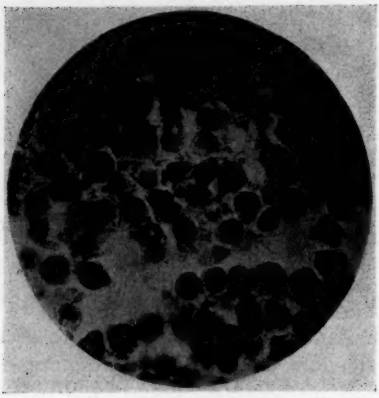


FIG. 5.

R.F., lymphosarcoma of eyelid. (×500)

I am indebted to Dr. A. Rankine, Director of Medical Services, for permission to publish official records connected with this case.

REFERENCES

1. **Smith, E. C. and Elmes, B. G. T.**—Malignant disease in natives of Nigeria: an analysis of five hundred tumours. *Annals of Tropical Medicine and Parasitology*, Vol. XXVIII, 1934.
2. **Friedenwald, J. S.**—The pathology of the eye, p. 280, 1930.

A MODIFICATION OF BOWMAN'S LACRYMAL PROBE

BY

E. J. SOMERSET

THE usual type of Bowman's lacrymal probe suffers from two disadvantages:—

(1) It is a double ended instrument which is usually used without gloves so that one end risks contamination from the hand.

(2) It is difficult to see the small numbers marked on the shaft and to know to which end they refer.

I have therefore had made a probe which is similar in general appearance to a very small urethral bougie. The numbers from

00, 0, 1, 2, etc., are marked on the plate at the top end and are easily seen. The lower end is similar to the Bowman probe and the numbers correspond.

The probes have been made for me by Messrs. John Weiss and Son of 287, Oxford Street, W.1 and have been used during the last few months and have proved satisfactory in every way.

ABSTRACTS

I.—UVEAL TRACT

(1) **Pavia, J. L. and Yrigoyen, L. (Buenos Aires).—Tuberculous macro-nodular iridocyclitis, spreading to the other parts of the eye. (Tuberculosis macro-nodular irido-ciliar con diseminacion al resto del ojo).** *Rev. Oto.-Neuro.-Oftal.*, Vol. XI, p. 185, July, 1936.

(1) **Pavia and Yrigoyen** describe a case of a child, aged eleven years, whose brother had pulmonary tuberculosis, and who was examined at a clinic to see if he had any early signs of the

condition. Signs were found in the lungs and a positive skin test was obtained.

Later, the child developed a pleural effusion on two occasions; following the second effusion he developed an irido-cyclitis, and was admitted to hospital. The condition was very severe and the eye had to be excised.

On examination the cornea was found to be infiltrated with lymphocytes. The inflammatory process was so intense, that at the angle no definite structures could be made out on account of the infiltration of lymphocytes and the interstitial proliferation.

Tuberculous nodules were invading the ciliary processes; some of them caseating; the anterior and posterior chambers were filled with tuberculous tissue, and no normal vitreous could be found.

E. E. CASS.

(2) **Malbran, J. and Androgue, E. (Buenos Aires).—Doyne's choroiditis. (Coroiditis de Doyne).** *Arch. de Oftal. de Buenos Aires*, Vol. XI, p. 529, 1936.

(2) **Malbran and Androgue** describe a case of this rare disease, which was first described by Doyne in 1899. Doyne discovered five out of a family of eight who were affected by this condition, which consists of small white spots in the papillo-macular region, some of them containing pigment.

The findings of other authors at later dates are given in detail. Treacher-Collins, in 1913, described the histological examination of a case. Alterations were found in the outer layers of the retina, similar to those changes occurring in " Drusenbilder." Hyaline deposits were found in the choroid, with nodules situated between the lamina vitrea and the retina. Lloyd, in 1936, included this condition among the heriditary macular degenerations, and noted that although the patients had good vision during youth, they had progressive failure of vision in later life.

The female sex is the most often affected, and the condition first appears about the age of puberty. The white patches in Doyne's choroiditis are larger than those found in Tay's and there is always pigment present. The differential diagnosis from retinitis albescens is that there are never any scotomata.

The authors have studied three families of Stargardt's degeneration, and say that whereas it affects both sexes, Doyne's choroiditis always affects the female sex. The case that they describe was that of a woman aged 20 years, who, however, had no family history of this condition.

E. E. CASS.

II.—RETINA

(1) **Allen, T. (Chicago).—Failures and successes in the operative treatment of detachment of the retina.** *Amer. Jl. of Ophthal.*, Vol. XIX, p. 1,000, 1936.

(1) **Allen** is impressed by the importance of a thorough general medical examination of a patient suffering from retinal detachment before undertaking operation, in particular, attention being paid to the cardio-vascular system and the possibility of post-operative haemorrhage.

In some cases he advocates a preliminary withdrawal of sub-retinal fluid in order to map out the precise site of retinal holes and to search for others that may have been hidden by folds of the detached area.

He comments on the difficulty of assessing the effect of electrolysis on the choroid and states that he prefers to use the Gradle electrode with the Walker diathermy outfit.

As regards drainage of sub-retinal fluid, an essential factor in retinal detachment surgery, the author feels that a 2 mm. trephine hole remains patent and affords effective drainage longer than a number of minute punctures, 60 of which may close up in as short a time as one. He thinks that early post-operative examination is bad and prefers to wait five or seven days before doing the first dressing.

H. B. STALLARD.

(2) **Spinelli (Bologna).—Diathermy coagulation in detachment of the retina. (Sulla terapia del distacco di retina con la diatermo-coagulazione).** *Boll. d'Ocul.*, October, 1936.

(2) The chief interest of this paper is the method of localisation adopted by **Spinelli**; he has attached to the Gullstrand ophthalmoscope, a perimeter arc which carries a moveable wire, which, illuminated, throws on the cornea an image of a point surrounded by a ring; the ring should coincide with the limbus and the point mark the centre of the cornea. By a system of mirrors the observer is able to explore the fundus and at the same time see that the circle is imposed on the limbus. In a sliding tube is a plane glass engraved with a cross marked in millimetres. By sliding, this cross can be made to form an image on the fundus. The observer reads the apparent size of the disc in millimetres and then the distance between the hole and the extreme visible periphery. Then, moving the eye until the centre of the cross coincides with the hole, he turns the arc of the perimeter and moves the wire until the luminous circle is imposed on the limbus, this gives the meridian in which the hole lies.

Knowing this and the distance of the hole from the limbus it is easy to plan the site of the operation.

HAROLD GRIMSDALE.

(3) **Rinaldi and Arslan (Padua).—Retinal exudate following sphenoidal sinus hyperostosis. (Retinite essudativa consecutiva a sinusite sfenoidale iperostosica).** *Boll. d'Ocul.*, October, 1936.

(3) Though inflammation of the nasal sinuses is recognised as a cause of retrobulbar neuritis, it is rare for the retina to be attacked. In the case related by **Rinaldi and Arslan** there was a large area of the retina extending from the nasal side below the disc to beyond the macula which was the seat of exudation, and was slightly raised. Vision was 6/12. The exudate hid the vessels, which beyond it, were engorged and tortuous. The nasal sinuses were cleared out and this was followed by speedy disappearance of the exudate and a return of vision to normal. The visual field, however, remained with loss of the superior half and the lower retinal arteries were converted into white cords. The authors think that the lesion was certainly not a simple blocking of the lower arteries but that the exudation was a separate process which may have occasioned the vascular changes.

HAROLD GRIMSDALE.

(4) **Androgue, E. and Malbran, J. (Buenos Aires).—Exudative retinitis and retinal cysts. (Retinitis Exudativa y Quistis de la Retina).** *Arch. de Oftal. de Buenos Aires*, March, 1936.

(4) **Androgue and Malbran** describe the diseases of Coats, Leber and von Hippel, and they consider there is a distinct difference between angiomatosis of the retina and retinitis exudativa externa; the latter disease is often limited to certain sectors of the fundus.

The condition is described in detail with its variations and the theories of its pathology, which have been observed by numerous recorders of cases.

The cause of retinitis exudativa externa has been thought to be due to tuberculosis, and that its toxins act either directly on the retina and the pigment epithelium, or indirectly, the numerous small vascular lesions produce alterations in the metabolism of the retina, such as occur in albuminuric retinitis. Some authors consider that the condition is due to syphilis.

The authors consider that vascular alterations are secondary, and when there is a primary vascular lesion, it is a true angiomatosis of the retina.

Cysts of the retina may be accompanied by pigmentary changes which are more or less characteristic of foci of perivasculitis, they occur most frequently in young people, and the authors report several cases of this condition.

Fuchs has divided retinal cysts into five groups, the first group concerns those secondary to detachment, these occur between the pigment epithelium and the rest of the retina. The second group is produced by traction, and cysts are formed on the inner part of the retina. The third group is formed by the shrinking of the retina. The fourth group occurs in secondary glaucoma without retinal detachment. The fifth group consists of cysts occurring in tumour of the choroid.

The authors describe two more groups of cysts, the first is the cystic degeneration secondary to primary tumours of the retina and the second, congenital cysts occurring in microphthalmic eyes with colobomata.

E. E. CASS.

III.—CONJUNCTIVA

(1) **Samuelson, A. (Stockholm).—Primary tuberculosis of the conjunctiva.** *Arch. of Ophthal.*, June, 1936.

(1) In his introductory remarks, **Samuelson** points out the rarity of this disease, its frequency at the Seraphimer Clinic being 1 in 60,000 cases if only primary ones are included, *i.e.*, those due to ectogenous infection. In a few instances, the disease has been localised to the bulbar conjunctiva but in the majority (70-80 per cent.) it is the palpebral conjunctiva which is affected. In all cases, there was swelling of the pre-auricular lymph gland and in several the cervical lymph nodes were also affected. Pre-auricular lymphadenitis is often the first symptom noted by the patient. On examination of the conjunctiva, ulcers, granulations and proliferative lesions are found. The Mantoux reaction is usually positive but if it can be performed before the body has had time to develop allergy, it is negative, as occurred in the case of a boy aged 16 years reported by Vancea. The disease is more commonly caused by the bovine than by the human bacillus, probably because tuberculous cattle are not usually treated as a source of infection. Diagnosis has to be made from other causes of the Parinaud syndrome (*e.g.*, primary syphilis of the conjunctiva, tularaemia, leptotrichosis and sporotrichosis of the conjunctiva) by histological examination and injection into guinea pigs of excised portions of the conjunctiva or preferably of the pre-auricular lymph gland.

So far as treatment is concerned the best results are obtained by Finsen light. The author gives the details of three cases in which this method was entirely successful.

F. A. W-N.

(2) **Aliquo-Mazzei (Siena).—Tubercle of the conjunctiva. (Sulla tubercolosi della congiuntiva).** *Boll. d'Ocul.*, August, 1936.

(2) **Mazzei** records two cases of tubercle of the conjunctiva, both of which were confirmed by inoculation of rabbits' eyes. Both cases were young boys; in the first, the diagnosis was helped by the evidence of tubercle elsewhere; the local lesion was a large ulcer on the upper tarsal surface surrounded by small papillary granulations; in the second case, the appearances of the upper lid suggested trachoma, but the presence of a dirty ulcer on the lower tarsus, and swelling of the pre-auricular gland suggested tubercle or Parinaud's conjunctivitis; the biological test showed tubercle. In this boy there were no other signs of tubercle and the author concludes that the disease was primary in the conjunctiva. He discusses the possibility of this, and decides that there must be some small lesion of the epithelium to allow the entrance of the bacilli; and that infection cannot take place through uninjured conjunctiva.

HAROLD GRIMSDALE.

(3) **Gardilcic, Ante (Zagreb).—On experiments with a new treatment of trachoma and its results. (Ueber Versuche mit einer neuartigen Trachombehandlung und deren Ergebnisse).** *Arch. f. Ophthal.*, Vol. CXXXV, p. 293.

(3) **Gardilcic's** experiments on the treatment of trachoma, which extended over a number of years, were at first directed to the use of alkaline substances to combat a local acidosis; the results with these alone, however, were mostly negative, although the principle underlying this form of attack was considered useful in combination with the action of other drugs.

He then turned his attention to oxidising agents, substances giving off free chlorine. Various hypochlorites were employed, both as drops and with massage, and it was found that salts of heavy metals, liberating active chlorine (of which a silver compound was best) were more effective than the hypochlorites of Na or K.

The use of nascent chlorine as the active principle does not satisfy the author in his search for an ideal agent in the treatment of trachoma in its various forms and complications, but in spite of certain disadvantages it was found more effective, better tolerated, and possesses a more varied action on the symptoms of

the disease than any of the other chemical agents usually employed. It has a beneficial effect on mixed infections and on scrofulous symptoms in trachoma and non-trachomatous cases.

As regards the conjunctiva, the swelling, redness and infiltration generally subsided after its use, as also the trachoma granules and the papillary hypertrophy.

Infiltrations of the cornea were absorbed by this mode of treatment more quickly than usually, and cases in which other drugs had been of no avail cleared up after its use. Corneal ulcers were checked and filled up with new tissue more quickly, and small maculae disappeared more or less completely.

Pannus too yielded to this treatment both in fresh cases and in advanced forms with subsequent improvement in vision (except in the cases with dense deep central opacities).

It was not possible to furnish exhaustive statistics as to the end-results, but while relapses due to various causes were observed the cures obtained in a large number of cases were lasting.

THOMAS SNOWBALL.

(4) **Selinger, E. (Chicago).—Quinine therapy in trachoma.** *Chinese Med. Jl.*, October, 1936.

(4) **Selinger** states that he has been treating trachoma with quinine for some years and has been able to bring about a cure with less trouble than with any other drug. He says that quinine from its physiological properties is admirably suited for use in trachoma. It is bactericidal, and as an alkaloid can penetrate mucous membranes. It is a poison to leucocytes and lymphocytes and therefore hinders their accumulation in the tissues. The method he employs is as follows. He uses a 10 per cent. solution quinine bisulphate; he arms a rod with wool and dipping it into the solution, rubs the everted lid with a firm rolling movement until the conjunctiva takes on a milky-bluish colour. A separate applicator is used for each lid so that four are needed for each treatment; the treatment should be applied twice or three times a week. In addition he gives the patient 2 per cent. ointment of quinine to be put in the lids night and morning. The application of the quinine is followed by slight burning which can usually be relieved by cold compresses.

HAROLD GRIMSDALE.

IV.—MISCELLANEOUS

(1) **Mutch, J. R. (Aberdeen).—The pupil after cervico-thoracic sympathetic ganglionectomy; photographic observations in man.** *Edin. Med. Jl.*, December, 1936.

(1) In a most interesting paper **Mutch** reports upon six patients in whom the sympathetic chain has been divided at known levels, based upon photography of the eyes. Five of these patients underwent a unilateral operation, and thereby the sound side served as a control. In one case, records were taken while operation was in progress, the others have been observed at intervals up to two years. In five cases the tissue removed consisted of the sympathetic chain from the second thoracic ganglion to the stellate ganglion inclusive. In the sixth case Telford's technique, in which the chain is divided below the stellate ganglion and again below the third thoracic ganglion and the intervening segment removed, was followed. " This modification was introduced by Telford in the belief that the sympathetic fibres in the first thoracic white ramus communicans are destined for the structures in the head and neck, so that by leaving it and the stellate ganglion intact, adequate sympathetic denervation of the arm is accomplished while the ocular results of the more extensive operation do not follow; this desirable result followed the one more limited operation." A full description of the technique used for photography is given and the nine figures on two plates show the results admirably. The author's conclusions are as follows.

" In man the position of the eyeball is unaltered after cervico-thoracic sympathetic neurectomy." In other words the enophthalmos which has often been described is more apparent than real.

" Narrowing of the palpebral fissure after the operation is due to raising of the lower lid, as well as to dropping of the upper lid. After sympathetic denervation, the pupil still responds to variations in illumination."

The paper is one that will repay perusal in the original.

R. R. J.

(2) **Maitland Ramsay, A.—The retinal circulation in cardio-vascular disease.** *Edin. Med. Jl.*, November, 1936.

(2) **Maitland Ramsay's** paper forms the seventh of a series of " Clinical Recollections and Reflections " now being published in the *Edinburgh Medical Journal*. The first half is mainly physiological in nature and the author states three postulates with regard to the retinal capillaries.

(1) That their distension accompanied by increased permeability of their walls to colloidal substances is the earliest sign of disease.

(2) That this may be recognised by lack of translucency of the ophthalmoscopic picture of the fundus oculi.

(3) That what can be seen with the ophthalmoscope in the eye is an index of what is taking place, hidden from view, in other parts of the body.

The retinal arteries are next considered with regard to hypertension, arterio sclerosis, haemorrhage from the retinal blood vessels, and retinitis; the last named being discussed under the headings of arterio-sclerotic, albuminuric and diabetic retinitis. The whole forms a very useful summary especially for the needs of the general practitioner; and illustrates a text on which the author is never tired of preaching, and rightly so, that the eye is part of the body and that the ophthalmic surgeon cannot be shut off in a water-tight compartment from general medicine. And that the more ophthalmology and general medicine are co-ordinated the better it will be for everyone concerned.

R. R. J.

(3) **Sai (Trieste).—Radiography of the cerebral vessels. (Angiografia cerebrale).** *Riv. Oto.-Neuro.-Oftal.*, January-February, March-April, May-June, 1936.

(3) In this long paper, which is very fully illustrated, **Sai** describes a method of photographing the cerebral vessels during life; though this subject has little direct bearing on ophthalmology, yet it has interest for ophthalmologists, since it enables the surgeon to see any disturbance in the course of the vessels in cases of cerebral tumour, and thus is of assistance in accurate diagnosis.

The method consists in injecting into the common or the internal carotid a substance, " thorotrast," which is opaque to X-rays and is innocuous. The radiogram must be taken immediately after the injection; five seconds later the thorotrast has passed out of the arteries into the veins and a second radiogram taken then, will show the venous circulation.

The operation, therefore, must be performed in the X-ray room with the plates in position before the artery is exposed and the injection made. The difficulty of securing asepsis in these conditions seems, from the author's account, to be the chief risk.

HAROLD GRIMSDALE.

(4) **Gerber, Alexander, and Lambert, Robert K. (New York).—Blue appearance of the fundus caused by prolonged ingestion of methylthionine Chloride.** *Arch. of Ophthal.*, September, 1936.

(4) Methylene blue has been used since 1880 as an intestinal antiseptic and since that date for many other conditions, such as carbon monoxide poisoning, tuberculous cystitis, gonorrhoea and malaria. In spite of this, **Gerber and Lambert** have been unable to find any reference in the literature to the ophthalmoscopic appearances produced by this drug. They therefore feel justified in reporting three cases in each of which the fundi appeared greenish blue, as though seen through a blue filter. The patients themselves were unaware of their condition and showed no departure from the normal in vision or visual fields. After absorbtion methylene blue remains in the tissues in a colourless form and does not appear blue except in the presence of oxygen. In the post-mortem examination of a patient who died from renal tuberculosis and had taken methylene blue for 18 months the bladder, prostate and rectum became blue almost immediately on exposure to the air. When the eye was opened it was seen that the vitreous was blue but sections showed no blueness in any cells of the retina or other coats of the eye. The authors cannot be sure that this was not due to the dye having been washed out during dehydration and fixation. They are of opinion, however, that the blue appearance of the fundus with the ophthalmoscope in the living subject is due to colouration of the vitreous rather than the retina. Why there should be enough oxygen in the vitreous to allow the blue colour to develop is problematical.

F. A. W-N.

(5) **Cohen, Henry, M.D. (Liverpool).—Optic atrophy as the presenting sign in pernicious anaemia.** *Lancet*, November 21, 1936.

(5) **Cohen's** paper was read at the meeting of the Association of British Neurologists at Edinburgh, June 12, 1936. In it he describes in detail two cases in which optic atrophy in apparently perfectly fit male subjects was the first sign of pernicious anaemia. The first case, aged 55 years, complained of failing vision for a year. A most searching examination disclosed little to account for the pallor of the discs which was present and the slight general contraction of the fields of vision. A diagnosis of optic atrophy, cause undetermined, was made. Close on six months later the man returned and was found to have pernicious anaemia. Treat- brought about a notable improvement in vision.

The second case, aged 46 years, gave a history of pernicious anaemia in his family. The eye condition was very similar to that

in case one. There was no clinical evidence of subacute combined degeneration or, at first sight, of pernicious anaemia, but with the first case in memory together with the family history the author established the diagnosis by blood count and gastric analysis. Treatment has led to a great improvement in vision.

In his discussion of these two cases the author lays stress upon the fact that nervous symptoms in pernicious anaemia arise from, (*a*) the anaemia itself with resulting defective nutrition of nerve elements; (*b*) loss of function followed by degeneration of nerve elements, due either to a toxin present in pernicious anaemia or the absence of a specific substance essential to neural nutrition; (*c*) areas of softening due to small haemorrhages or thromboses. Only those symptoms resulting from temporary loss of function and due chiefly to the first two of these factors are potentially curable, regeneration in the central nervous system being absent.

All of us in the past must have met with cases of optic atrophy for which we could find no cause. It is to be hoped that the author's work here abstracted will lead to a diminution in the number of such cases.

R. R. J.

(6) **Wood, D. J. (Cape Town).—Avulsion of an eye.** *South African Med. Jl.*, September, 1936.

(6) The case reported by **Wood** must be of extraordinary rarity. A man was admitted to hospital as an emergency case with a history of assault and stabbing in the left eye with a penknife. The globe was found protruding from the orbit and lay well beyond the eyelids. It was attached below by a small amount of fascia, and what appeared to be the tendon of the inferior rectus muscle. This was divided and the eye was removed with about two inches of nerve attached. There was no evidence of shock, though the man felt sick and haemorrhage was trifling in amount. There were, in addition to the main injury, two incised wounds, one at the outer canthus and one in the middle of the upper lid. A probe passed deeply through this along the orbital roof, but not into the orbital cavity.

Next day the patient complained of headache and blurring of vision in the remaining eye. Vision was 6/6, but the field was very much contracted. Two days later the field was found to be larger in size but some loss of field in the upper temporal quadrant was present on discharge from hospital. The patient's statement was that " as he was stabbed his assailant thrust his thumb into the orbit, forced his eye up and out, and then pushed it forwards with the knife."

On examination the eyeball was found unruptured; the recti muscles had their tendinous ends left attached, rather less than

1 cm. of each. The inferior oblique showed only a stump of tendon, and the superior oblique, about one inch.

The optic nerve measured 4·7 cm. in length. It possessed its dural sheath for nearly 2·7 cm., beyond this it was bare for about 2 cm., that is the length of the nerve in the optic canal and cranial cavity.

The author notes that, on account of the anatomical arrangement of the fibres of the chiasma, " avulsion of a nerve from its chiasmal end will therefore be liable to damage the lower nasal decussating fibres from the opposite eye, and an upper temporal hemianopia is just what should, and did occur. Whether the initial small fields were quite genuine is uncertain, but one can imagine a condition of oedema, or of haemorrhage into the chiasma which, on clearing, allowed the restoration of most of the field. The field is now full except in the upper outer segment, where some contraction is still present."

R. R. J.

(7) **Triandaf, E. and Nitzulesar (Rumania).—Ocular manifestations in trichinosis. (Manifestations oculaires dans la trichinose).** *Arch. d'Ophtal.*, Vol. LIII, p. 47, 1936.

(7) **Triandaf and Nitzulesar** review the literature of the ocular complications of trichinosis among which they mention oedema of the lid; sanguineous suffusion of the conjunctiva; the presence of parasites in the extra-ocular muscles and pain on movement of the eyes; exophthalmos; mydriasis; paralysis of accommodation; retinal haemorrhages and dilatation of the retinal veins; parasites in the retina and lesions in the outer nuclear and molecular layers, particularly around the capillaries. They report a family of three, father, mother, and a daughter who after eating some pork infected by the parasite became ill. The mother's symptoms were more severe than those of the other two who were but slightly affected. Oedema and tremor of the lids, painful ocular movements, defective distance and near vision were among the ocular manifestations. Eosinophilia, 17 to 18 per cent., was present in all three cases.

H. B. STALLARD.

(8) **Weingott, L. (Varsoire).—Pathogenesis, aetiology and treatment of glaucomatous iridocyclitis.** *Arch. d'Ophtal.*, Vol. LIII, p. 672, 1936.

(8) **Weingott** discusses at length the pathogenic factors which lead to inflammation of the iris and ciliary body and to a rise of intra-ocular pressure. He stresses the importance of a thorough search for the cause and a careful general medical examination to determine the state of the patients' tissues, in particular those upon which the infective agent is operating. He gives clinical examples

of cases of glaucomatous iridocyclitis in which a gonococcal focus was tracked down in the prostate and joints and associated with this were certain vascular degenerative changes due to alcoholism and syphilis. In the treatment of such cases he points out the importance of treating not only the cause but any associated disease. His case reports show some remarkable successes with gonococcal vaccine and, indeed, he feels that many cases of glaucomatous iridocyclitis will respond satisfactorily to medical attention and will not require an operation.

H. B. STALLARD.

(9) **Lewis, G. E., Raines, R. and Stewart, D. Stenhouse (Hull).— Uveo-parotitis.** *Lancet*, Vol. CCXXXI, p. 1204, 1936.

(9) **Lewis, Raines and Stenhouse** review the literature of uveo-parotitis and describe the clinical course of a case under their care the general medical features of which began with a mild phlebitis of the legs, a carbuncle on the lip, unresolved right lower lobar pneumonia, septicaemia, pyuria and later angio-neurotic oedema. The patient's father had died from tuberculosis. Parotitis preceded iritis and in spite of a normal intra-ocular pressure during the illness the optic disc of the affected eye became cupped on the temporal side with a nasal field loss. The patient recovered completely but later had an urticarial rash, some angioneurotic oedema and a fainting attack.

In discussing the aetiology the authors are disposed to regard the disease as a local manifestation possibly due to any one of a variety of allergens which operate selectively on specifically hypersensitised tissues. Whilst tuberculin may often be the responsible allergen they do not feel justified in regarding all cases of uveo-parotitis as tuberculous.

H. B. STALLARD.

(10) **A. May Vianna (Faro, Portugal). — Auto-ophthalmoscopy. (L'auto-examen du fond de l'oeil).** *Ann. d'Ocul.*, Vol. CLXXII, p. 936, 1935.

(10) When looking into a plane mirror at 20 cm. distance with a +13 D. lens in front of one eye, the other eye using an electric ophthalmoscope can see only a part of the temporal fundus. The optic disc will not be visible as the angle between the visual axes of the right and the left eye is too small. In order to see the disc and its surroundings it is necessary to displace the image of the observed eye more laterally by putting a properly inclined plane mirror, or better, a prism between the eye and the lens. It is an advantage to make the observing eye 3 to 4 D. myopic. A mydriatic has not been used for these auto-examinations.

HUMPHREY NEAME.

BOOK NOTICES

Transactions of the American Ophthalmological Society. 1936.

The 72nd annual meeting of the American Ophthalmological Society was held at Hot Springs, Virginia, on June 1, 1936.

The transactions fill nearly 400 pages and besides recording the proceedings include obituary notices of several eminent American ophthalmic surgeons.

It is liberally illustrated and contains much of interest. We hope to abstract some of the more important papers in due course.

CORRESPONDENCE

To the Editors of THE BRITISH JOURNAL OF OPHTHALMOLOGY.

DEAR SIRS,—May I be permitted to draw your readers' attention to an omission occurring in my paper on Doyne's Choroiditis, which appeared in the February issue of the *Brit. Jl. of Ophthal.*

I should have liked to call attention to the fact that the original fundus paintings of cases 3, 4, 6 and 7 are part of the University of Oxford Collection of fundus pictures, and may be seen at the Oxford Eye Hospital.

Yours faithfully,

M. TREE.

81, AMHURST PARK, N.16
February 11, 1937.

TRAINING IN ORTHOPTICS

To the Editors of THE BRITISH JOURNAL OF OPHTHALMOLOGY.

DEAR SIRS,—It may interest your readers to know something of the work of the Orthoptic Board which was formed in 1934 and upon which many hospitals both in London and the Provinces are already represented. We are working under the auspices of the Council of British Ophthalmologists and have introduced a syllabus for the training of orthoptic students in the associated hospitals. The Board holds examinations twice a year, and upon its recommendation the Council of British Ophthalmologists is issuing certificates of proficiency to successful candidates. Students must, before commencing study, have passed the school certificate, the

senior certificate of the College of Preceptors or have matriculated at one of the senior Universities. They must be not less than 18 years of age. The course of training is for one year.

Those who are properly trained in the principles of orthoptics can develop the faculty of binocular vision to a surprising degree in patients in whom it is deficient, and many ophthalmic surgeons will agree that the results of treatment of squint cases can thereby be greatly improved. Unfortunately, it is also true that considerable harm can be done when training is carried out by those who do not fully understand the principles involved and the whole subject is thus brought into disrepute.

The Board is anxious that it should be as widely known as possible that there are a number of trained and qualified Orthoptists of good standing available for service.

Yours truly,

CHARLES LEONARD GIMBLETT,
Chairman.

NOTES

Henry Blackburne, Charlatan

SOME facts about this man are to be found in Sloane MS. 3801, transcribed in the History of Ophthalmology in England prior to 1800, p. 54. It may be of interest to note that he received the Archbishop of Canterbury's licence to practise on August 9, 1605. Register Bancroft, fo. 133 b. The licence is of the usual type and is in Latin, the relevant parts of which are as follow:—

Henry Blackborne *in arte chirurgie Professor.* He was vouched for by certain doctors of medicine and his licence runs: *Ad practicandum igitur et exercendum in arte chirurgie et presentim in arte sive facultate curacionis morborum circa oculos incidentium.*

His licence allowed him to practise throughout the Province of Canterbury, with the exception of the diocese of London.

We are indebted to His Grace the Archbishop of Canterbury for permission to record this note.

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History of Lanarkshire

AT the time of his death last year Dr. J. A. Wilson, of Cambuslang, who was one of our contributors, was preparing a History of Lanarkshire for publication. The first volume has recently been published by J. Wylie & Co., of Glasgow. It deals with the subject

according to parishes and contains lists of the Pre-reformation clergy with notes on their lives, as well as much of interest. This volume contains more than 100 illustrations and costs 21/- net. It is a matter for regret that Dr. Wilson did not live to see his work in print. We hope that there will be a large demand for it. The second volume is being prepared for publication.

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Royal Medical Benevolent Fund

IN the hope of obtaining the direct support of every practitioner, the Fund is issuing a FIVE SHILLING APPEAL to 21,000 members of the profession in England, Scotland and Wales who have not responded to the Centenary Appeal made in April, 1936. If all who receive the appeal will sign a Banker's Order for *only 5/-*, the income of the Fund will be increased by £5,250 a year, a sum which is very urgently needed.

Please help to make this appeal a success.

11, CHANDOS STREET,
CAVENDISH SQUARE,
LONDON, W.1

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Société française d'ophtalmologie

THIS year is 50th anniversary of foundation of La Société française d'ophtalmologie. The International Society for Prevention of Blindness and the International Council of Ophthalmology hold sittings during the Congress. English members will be very welcome. Further information as to membership can be obtained from Mr. MacCallan, 33, Welbeck Street, W.1.

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Corrigendum

IN the March number of this Journal, p. 154, the last two sentences, we regret the omission of a line of print. The termination of the last sentence but one and the beginning of the last sentence should read thus:— . . . , being due rather to upgrowth of surrounding parts than to actual epithelial penetration. The paper is profusely illustrated with excellent microphotographs and drawings . . . .

FUTURE ARRANGEMENTS

1937

April 9.—North of England Ophthalmological Society, at Sheffield.
April 16.—Midland Ophthalmological Society, at the Nottingham Eye Infirmary.

April 29, 30 and May 1.—The Annual Congress of the Ophthalmological Society of the United Kingdom to be held at the Royal Society of Medicine, 1, Wimpole Street, London, W.1.

June 4.—Midland Ophthalmological Society, at Shrewsbury Eye Hospital.

June 11.—Royal Society of Medicine; Section of Ophthalmology (Annual).

July 8-10.—Oxford Ophthalmological Congress, at Oxford.

October 1—Midland Ophthalmological Society, at the Eye Hospital, Birmingham (Annual Meeting).

December 7.—Midland Ophthalmological Society, at Birmingham Eye Hospital (Middlemore Lecture).

CONTEMPORARY OPHTHALMIC LITERATURE

American Journal of Ophthalmology. *February, 1937.*

WRIGHT. Lectures on cataract.
BATTMAN and BARKAN. Trichloracetic acid in the treatment of iris prolapse.
TROWBRIDGE. Sympathetic ophthalmia.
KING. Chronic traumatic subdural haematoma as a cause of choked disc.
ESSEX and CORWIN. Experimental "exophthalmos" in dogs.
SALIT. Total lipids of human cataractous and sclerosed lenses.
MILLER. Modification of the Desmarres operation for transplantation of the pterygium.
POST. Neo-synephrine.
DURR. The O'Connor cinch-operation technique.

Annales d'Oculistique. *January, 1937.*

HARTMANN and GUILLAUMAT. Ocular symptoms of supra-sellar meningiomata.
SCHIFF-WERTHEIMER. The situation of retinal tears.
AVERBACH. Note on expulsive haemorrhage.
PACALIN. Stereoscopic vision without a stereoscope.

February, 1937.

SÉDAN and JAYLE. Considerations on spasm of the central retinal artery.
SOLIGNAC. Contribution to the study of the aetiology and pathogenesis of the chalazion.

Archiv für Ophthalmologie. *February, 1937.*

BEHR. Ocular changes in Schuller-Christian-Handschen's disease.
LÖHLEIN. Some malformations which are recognized as causing lowered resistance from the ophthalmologist's standpoint.
LOBECK. The diameter of the retinal vessels in healthy and ill men.
BAAS. The history of German ophthalmology in the middle ages.

NAKAMURA, UCHIDA and NAKAMURA, O. The one sided permeability of the flexible membranes of the eye.
SERR. Clinical experience with the new Zeiss projection-perimeter (after Maggiore).

Klinische Monatsblätter für Augenheilkunde. *January, 1937.*

PEPPMÜLLER. A hitherto undescribed bilateral symmetrical sub-epithelial corneal opacity in a case of Paget's osteitis deformans.
WEGNER. Observations on the aetiology of chronic inflammations of the eye.
VELHAGEN. Purulent iridocyclitis with intra-ocular gonococci.
PURTSCHER and DIBOLD. Intra-capsular cataract extraction in diabetics.
VELHAGEN, K. Sarcoma of the lacrymal sac.
PAVIA. The green spot in the fundus, New methods in differential diagnosis and new facts.
KAMOGAWA. Blood pressure alterations in the central retinal artery during postural changes in convalescent patients.
GRANSTRÖM. A case of Oguchi's disease in Sweden.
LUTZ. Correction of the work of N. von Horansky on "The geniculate body and visual cortex in monocular optic atrophy.

Annali di Ottalmologia e Clinica Oculistica. *August, 1936.*

RINALDI. Vitamins A and D in the local treatment of corneal lesions. (Experimental and clinical research.)
CORRADO. The behaviour of the ocular tissues under the action of chemical and pharmacological substances introduced into the anterior chamber and vitreous (Experimental and histopathological research.)
CAMPOS. Research on retinal compensation.

September, 1936.

CAMPOS. Research on retinal compensation.
TROVATI. Vascular modifications of the normal ocular fundus from the action of the short wave.
SPADAVECCHIA. The general arterial pressure and the ocular tone. Clinico-experimental research.

October, 1936.

RINALDI. Experimental research on the property of the antigen of the corneal protein.
MARUCCI. Retinal angiospasm.
SPADAVECCHIA. The general arterial pressure and the ocular tone. Clinico-experimental research.

Bollettino d'Oculistica. *December, 1936.*

CASSUTO. Conjunctival affections from bipolar bacilli. Two cases of bacilli localized in the bulbar conjunctiva in haemorrhagic septicaemia.
BIETTI. The utility of Marconi therapy (ultra-short waves) in some ocular affections.
MORETTI. Acute haemorrhagic bulla of the cornea.
CADEI. A case of voluminous glandular cysts of the conjunctiva of traumatic origin.
CIOTOLA. Unilateral Argyll Robertson symptoms following herpes ophthalmicus.

Revista Cubana de Oto-Neuro-Oftalmiatria. *Sept.-Oct., 1936.*

ALAMILLA and BRANLY. Orbital cellulitis in infancy.
YANES. Interventions on single eyes.